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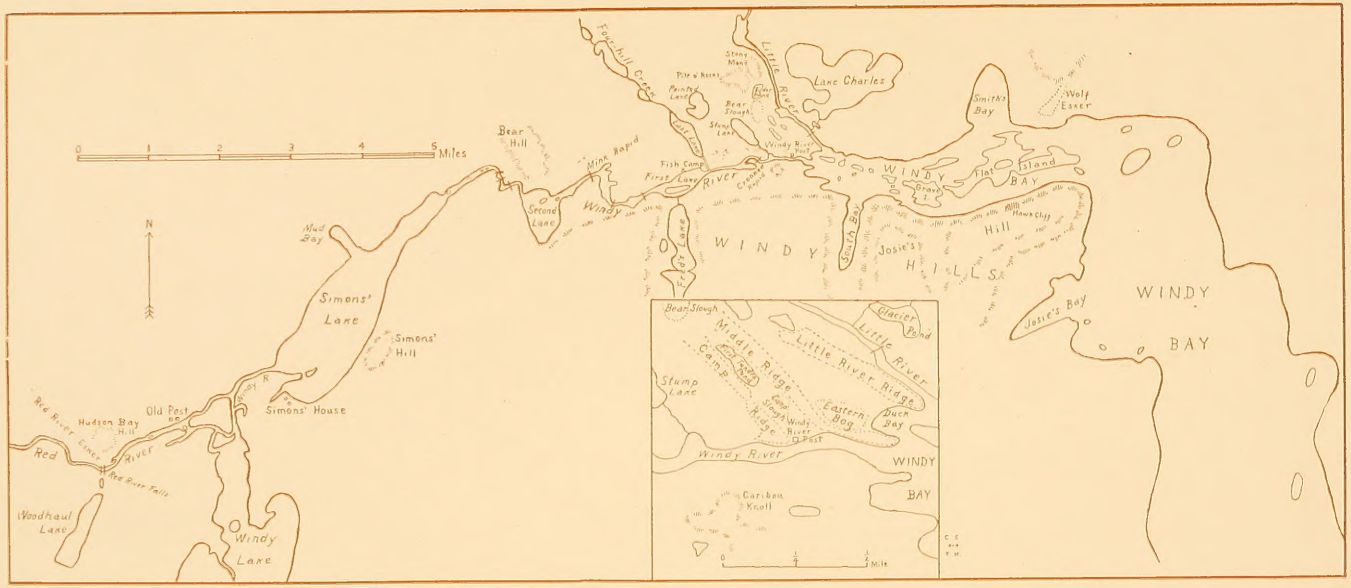
The Barren Ground Caribou of Keewatin

FRANCIS HARPER



MAP 1. The Windy River area at the northwestern extremity of Nueltin Lake, Keewatin. (Most of the smaller features bear merely local or unofficial names.)

COVER A Caribou buck signaling with a sprawling posture of the left hind leg. Drawing by Earl L. Poole; based upon a motion-picture film taken August 24, 1947, near the Windy River post.

THE
BARREN GROUND CARIBOU
OF KEEWATIN

THE BARREN GROUND CARIBOU OF KEEWATIN

BY
FRANCIS HARPER

UNIVERSITY OF KANSAS
LAWRENCE • KANSAS

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Introduction

No other large North American land mammal is of such primary importance as the Barren Ground Caribou (*Rangifer arcticus arcticus*) as a source of food and clothing for so many primitive Eskimo and Indian tribes; no other performs such extensive and spectacular migrations; no other may be seen in such vast herds; no other exhibits so close an approach to a Garden-of-Eden trustfulness in the presence of man. And perhaps no other is more worthy of being cherished and safeguarded in its natural haunts for the benefit and enjoyment of future generations.

The original valid designation, in technical nomenclature, of the Barren Ground Caribou of the Mackenzie-Keewatin region dates back to 1829, when Sir John Richardson described it in the *Fauna Boreali-Americana* as *Cervus tarandus* var. *arctica*. The type locality is Fort Enterprise (about lat. 64° 30′ N., long. 113° W.), on Winter Lake, an expansion of Snare River, Mackenzie. Since the typical subspecies appears to lack a distinguishing common name, it would seem fitting to associate with it the name of its worthy describer; thus, Richardson's Barren Ground Caribou. The author's intimate acquaintance with the animal should have enabled him to draw up a somewhat fuller and more adequate description than he did. Previous travelers in the Barren Grounds, among whom Samuel Hearne (1795) was particularly notable, had contributed accounts of the species, without differentiating it from the Lapland Reindeer (*Rangifer tarandus*) or without giving it a distinctive technical name.

Since Richardson's time the mainland form of western Canada has been discussed by many zoologists and explorers. The most comprehensive account of its life history hitherto published is that by Seton (1929, **3**: 95-135),[1] whose personal experience was gained in the region of Artillery, Clinton-Colden, and Aylmer lakes. Dearth of adequate material (particularly from the type locality or adjacent areas) makes it all but impossible to determine whether there is any significant geographical variation between the herds of central Mackenzie and those of Keewatin.

The foremost objective of an expedition I made in 1947 to Nueltin Lake, in southwestern Keewatin, was a study of the Barren Ground Caribou. The expedition was supported by the Arctic In-

1. This statement, written long before the appearance of Banfield's work of 1954, no longer applies.

stitute of North America, with funds supplied by the Office of Naval Research. My headquarters were at the little Windy River trading post, at the northwestern extremity of Nueltin Lake (map 1). There, for a period of six months, I enjoyed the fine hospitality of Charles Schweder and Fred Schweder, Jr. They had lived on intimate terms with the Caribou during most of their youthful lives, and they freely shared with me the knowledge they had thus gained concerning the ways of life of these wonderful creatures. They secured nearly all the specimens that went into my collection. The three other residents of the post also deserve my gratitude for their general helpfulness and friendliness; they were 10-year-old Mike Schweder (brother of Charles and Fred), 15-year-old Anoteelik (an Eskimo boy), and the latter's sister, 5-year-old Rita.

In a previous paper (1953) I have endeavored to express to various officials and friends my sincere appreciation of their courtesy and generosity in furthering the work of the expedition; and I can scarcely forbear to repeat here the names of at least a few of them: Dr. A. L. Washburn, at that time executive director of the Arctic Institute of North America; Mr. R. A. Gibson, deputy commissioner of the Administration of the Northwest Territories; and Mr. G. W. Malaher, director of the Game and Fisheries Branch, Manitoba. For the loan of a motion-picture camera, which secured for me some extremely gratifying scenes of the migrant hosts on the Barrens, I am greatly indebted to Mr. William C. Morrow. Dr. Ralph S. Palmer has kindly read, and made helpful comments upon, a preliminary draft of the present report.

Through the courtesy of the American Museum of Natural History, the United States National Museum, and the United States Fish and Wildlife Service, I have been able to examine important comparative material in their collections.

A grant from the National Science Foundation has enabled me to carry the investigation through to completion.

Migrations

The Barren Ground Caribou is the outstanding migratory land mammal of North America at the present day. (Some of the bats, though extensively migratory, obviously belong in a category too distinct for comparison.) We know as yet extremely little concerning the movements of individual Caribou;[2] but it is fairly safe to assume that among those reaching the southern limits of the winter range in central Manitoba or northwestern Ontario, there must be many whose summer range is at least 500 or 600 miles to the northward. The latitudinal extent of such wanderings is comparable with, or equivalent to, an annual round trip between Philadelphia, Pennsylvania, and Charleston, South Carolina. There is perhaps less information available concerning the migrations of the wild Reindeer of the Old World than concerning the movements of the Barren Ground Caribou of North America (*cf.* Jacobi, 1931: 191-200).

Southern limits of winter range

In years long past the winter range extended at least occasionally as far south as Fort McMurray in Alberta and Cree Lake and the upper Mudjatick and Foster rivers in Saskatchewan, and rather regularly to Reindeer Lake (Preble, 1908: 137); and "on rare occasions as far south as Cumberland House on the Saskatchewan River" (Buchanan, 1920: 105). At an early date Richardson believed (1829: 243) that "none" of these Caribou "go to the southward of Churchill."

There are, however, records of long ago that deal with mass occurrences of Caribou on the lower courses of the Nelson, Hayes, and Severn rivers, emptying on the west coast of Hudson Bay. The records are very puzzling in several respects. Most of them do not definitely differentiate the species involved from the Barren Ground Caribou, but some of them (by Hearne, Richardson, and Preble) indicate that it is the Woodland Caribou. The direction of the migrations, as reported in some instances, is just the reverse of that taken at the present time by the Barren Ground species during its normal movements at corresponding seasons. Finally, it is all but impossible to reconcile the numbers reported with such knowledge

2. One means of gathering information on this subject would be to capture fawns as they swim across lakes or wide rivers on the autumn migration, then to affix numbered metal tags to their ears and to release them in time to rejoin their mothers. This would simply be a modification of the leg-banding method that has proved so highly successful in the study of bird migration. It would also be particularly useful in studies on age and growth.

as we have of the status of the Woodland Caribou at any other period or in any other region.

Perhaps the earliest account is by Dobbs (1744: 22):

"They [residents at Fort Bourbon-York Factory] also take great numbers of Cariboux or Rain-Deer [sp.?]. In *March* and *April* they come from the North to the South, and extend then along the River 60 Leagues; they go again Northward in *July* and *August;* the Roads they make in the Snow are as well padded, and cross each other as often as the Streets in Paris."

In discussing the "Indian deer" or Woodland Caribou in the vicinity of Great Slave Lake, Hearne remarks (1795: 225): "This is that species of deer which are found so plentiful near York Fort and Severn River."

According to Thompson (1916: 100-101), an immense herd of "Rein Deer" [sp.?], estimated at the rather preposterous figure of 3,564,000 individuals, crossed the Hayes River 20 miles above York Factory in late May, 1792. The direction of this migration is not indicated.

Richardson writes ("1825": 330) of the Woodland Caribou: "In the beginning of September, vast numbers of this kind of deer pass near York Factory . . . on their journey towards the north-west."

And again (1829: 250):

"They cross the Nelson and Severn Rivers in immense herds in the month of May, pass the summer on the low, marshy shores of James' Bay, and return to the northward, and at the same time retire more inland in the month of September. . . . I have been informed by several of the residents at York Factory that the herds are sometimes so large as to require several hours to cross the river in a crowded phalanx."

The implication is that the herds passed *southward* in May. It should be borne in mind that these were apparently not personal observations of Richardson's; and in his belief that the Barren Ground species did not go south of Churchill, he may have merely assumed that the animals in the York Factory region were the Woodland species.

"Near York Factory, in 1831, this propensity [Indian destructiveness] . . . led to the indiscriminate destruction of a countless herd of reindeer [sp.?], while crossing the broad stream of Haye's River, in the height of summer. . . . The deer have never since visited that part of the country in similar numbers." (Simpson, 1843: 76).

Referring to the York Factory region in 1837, John McLean writes (1932 [1849]: 195). "Not many years ago this part of the country was periodically visited by immense herds of rein-deer; at present there is scarcely one to be found."

A later account of Richardson's (1852: 290) is somewhat ambiguous as to the species to which it refers:

"The reindeer that visit Hudson's Bay travel southward toward James's Bay in spring. In the year 1833, vast numbers of them were killed by the Cree Indians at a noted pass three or four days march above York Factory. They were on their return northward, and were crossing Hayes River in incredible multitudes."

Pike writes (1917 [1892]: 50) that "within the last three years [*i.e.*, about 1888] the [Barren Ground?] caribou have appeared in their thousands at York Factory . . . where they have not been seen for over thirty years."

Preble (1902: 41) quotes Dr. Alexander Milne as thinking, after 14 years' residence at York Factory, that the small bands of "Woodland Caribou," found between Churchill and Cape Churchill, form the "northern fringe of the bands which migrate to the coast in spring, the great majority of which in their journey cross to the south of Nelson River." At that time, however, Preble (1902: 42), like Richardson before him, seems to have regarded the Churchill River as the southern limit of the Barren Ground species, and thus he may not have considered the possibility of the animals of Cape Churchill and the Nelson and Hayes rivers belonging to the same species.

It is difficult to draw any sure conclusions from the confusing records just quoted. Possibly chief reliance should be placed upon the testimony of such high authorities as Hearne, Richardson, and Preble when they refer to the animals as Woodland Caribou. Furthermore, none of the early writers identify them unequivocally as the Barren Ground species. It remains fairly evident that long ago some species of Caribou in great numbers did actually cross these rivers in a southerly direction in the spring, pass the summer on the coastal tundra east of York Factory, and return northward or northwestward in late summer or autumn. Whichever species it was, it represented a segment of the population that must have become reduced to utterly insignificant numbers, if not entirely extirpated, some decades ago. In any event, it does not seem very

likely that we shall ever be able to reconstruct the actual movements of the "incredible multitudes" in the York Factory region of more than a century ago.

Since the beginning of the present century, until very recent years, there seem to have been few or no Manitoba records of *R. a. arcticus* from any locality so far to the southeast as York Factory. In 1947, however, Mr. G. W. Malaher, director of the Game and Fisheries Branch in Manitoba, informed me that during the previous couple of winters the animals had ranged southward on a broad front to the latitude of Oxford House, where they had not been known for 40 or 45 years. It was surmised that the recent burning of large areas north of The Pas, resulting in the destruction of the Caribou's normal winter food of lichens, had deflected the animals toward the southeast and had caused them to extend their migration beyond its normal limit. The Split Lake band of Indians (on the Nelson River) were said to have killed 4,000 Caribou during the winter of 1946-47, and to have used half of them for dog feed.

Arthur H. Lamont, in charge of the meteorological office at Fort Churchill, gave me information concerning Caribou that he had seen during a plane flight from that point to Edmonton on March 18, 1947. At midday he had sighted hundreds, in bands averaging 20 to 30 individuals, on some little lakes, averaging a quarter of a mile in diameter, near the southwestern end of Reindeer Lake. The animals were right in the middle of the frozen lakes (evidently for a noonday rest), and some of them were lying down. They paid no attention to the plane at a height of 6,000 feet, but were frightened when it came down to 200 feet. This was the only area where Caribou were sighted during the entire flight.

Duncan A. McLeod, of Winnipeg, informed me that he had seen thousands and thousands of Caribou on April 16, 1941, while he was flying from Isle à la Crosse to Beaverlodge on Lake Athabaska. They were nearer to Lake Athabaska than to the starting-point. They were congregated on frozen lakes about the middle of the day.

"Their nomadic migrations during the past 10 years have brought caribou herds during winter months to northwestern Ontario (Little Sachigo Lake); central Manitoba (Cormorant, Cross, and Island Lakes); northern Saskatchewan (Churchill River); northeastern Alberta (Clearwater and Athabaska Rivers and Lake Claire)" (Banfield, 1949: 478, fig. 1).

Spring migration in the Churchill region

The Hudson Bay Railway is perhaps the only one in North America from which Barren Ground Caribou of the present subspecies have been seen. On May 21, 1947, a passenger reported three or four of the animals near Mile 326, between Gillam and Amery. Farther north, between Herchmer and Chesnaye, the railway passes for perhaps 30-40 miles through the western edge of a tundra area, interspersed with small spruce timber; this is known as the "Little Barrens." It was a thrilling experience to see my first Caribou here, during a period of three-quarters of an hour on the afternoon of May 21, from Mile 453 to about Mile 475. There were eight bands, varying in number from 2 to 60 or 70 and averaging about 20 individuals. The first and largest band was loping away from the train, at a distance of perhaps 350 yards. A band of 9 or 10, at about 250 yards, exhibited both a trotting and a loping gait. Others, as far off as half a mile or a mile and therefore less alarmed, seemed to content themselves with trotting. They maintained a noticeably close formation while fleeing from the train. Yearlings, appearing only about half the size of the adults, were readily distinguishable. The animals were in the midst of their spring migration and were evidently moving in a general northerly direction over the snow-covered Barrens. The ice of the small lakes was still solid enough for the Caribou to trot over it.

Two weeks previously a large movement had passed through this area, as I learned from several sources. A member of the Royal Canadian Mounted Police detachment at Churchill, for example, had traveled through the Caribou for a distance of 15 miles without coming to the end of them; he estimated their numbers at more than 5,000. Joe Chambers, a trapper of Goose Creek, said the animals had been very plentiful in April, moving generally northward. He spoke of finding a good many Caribou that Wolves had killed, contenting themselves with eating only the tongue and the unborn fawn.

According to a railway conductor, only 12 Caribou were seen from the train as it passed through the Little Barrens on May 25, and none on May 28.

John Ingebrigtsen, of Churchill, reported passing a frozen lake somewhere east of the Duck Lake Post, that was "absolutely full" of Caribou. It was about a mile and a half long by half a mile wide, and he estimated the number of animals at not less than 20,000.

This was in the early part of May, 1942 or 1943, when the spring migration was no doubt under way.

During a plane flight from Eskimo Point to Baker Lake on May 22, 1947, John M. Bourassa and Don Gallagher sighted numbers of Caribou, including one herd of about 500. On May 28 the former saw a Caribou between Churchill and Fort Churchill. From other sources I learned that small numbers occasionally pass along the outskirts of Churchill during the migrations.

Professor Hazel R. Ellis (*in litt.*, April 13, 1953) reports seeing several bands of Caribou from the train as it approached Churchill on June 8, 1947; also a band between Churchill and Fort Churchill on June 13 and 21, 1949, and a single animal on June 28, 1949, on the west side of the river near Churchill. On July 5, 1949, she filmed a herd of over 40 Caribou at Bird Cove on Cape Churchill.

Preble writes (1902: 41): "Between York Factory and Fort Churchill a few small bands [of Woodland Caribou] are found throughout the year on the 'Barrens'." He includes reports to this effect from several sources, including J. W. Tyrrell (1898). The latter, however, does not specify which species of Caribou his party encountered. It might be expected that *R. a. arcticus*, rather than *R. caribou sylvestris*, would be the proper inhabitant of this tundra area. It is beyond question that the animals seen in recent years on the "Little Barrens" between the Churchill and the Nelson Rivers are the Barren Ground species. Furthermore, Mr. G. W. Malaher, of the Manitoba Game and Fisheries Branch, informed me that a considerable number of this species spend the summer and have their fawns on the Barrens in this area.

Spring migration in the Nueltin Lake region

The general pattern of this migration, as manifested particularly about the northwestern portion of the lake, was explained by Charles Schweder. As a rule, practically all the local Caribou spend the winter in the wooded country to the southward. When the northward movement starts in the spring, the does precede the bucks; they migrate through this area mostly in May (and apparently more commonly in the latter half of the month), but to some extent in April or even earlier. During June the majority of the animals passing by are bucks. According to Fred Schweder, Jr., the spring migration here is more regular, less erratic, than the fall migration.

When I arrived at Nueltin Lake on May 31, the spring migra-

tion was in full swing; it continued through June in gradually lessening force, and the last northbound band was seen on July 1. In the meantime many interesting details of caribou behavior came to light.

While flying from Churchill to Duck Lake Post on May 31, at a height of about 500 feet, we detected three bands on the frozen surface of Seal River, where they were evidently taking a noonday rest. They numbered approximately 40, 20, and 6 individuals. Within 20 minutes after resuming our journey, from Duck Lake Post to Nueltin Lake, we saw four more bands, numbering from two to a dozen individuals. Finally, just before landing on Windy Bay, we noticed a band of perhaps 20 crossing the bay a mile from its head.

Observations during the following 10 days showed that this was a very definite crossing-place for the Caribou, as if some invisible barrier on each side kept them to a certain line of march. Moreover, Charles Schweder informed me that they followed this identical route year after year. An examination of the local topography (map 1) soon revealed the reason. The rugged south side of Windy Bay rises steeply for some 500 feet to the summit of the Windy Hills, and over a considerable distance there are precipices and talus slopes barring the passage of such animals as Caribou. But the mile-long South Bay, meeting Windy Bay at right angles, affords a convenient break in the hills; and the slopes thereabouts are gradual enough to be negotiated readily by the Caribou. So here they converge from the neighboring heights, making long, slanting trails through the snow that are visible for miles; they pass out of the narrow mouth of South Bay as through a funnel, then follow the beaten path of their predecessors across the ice of Windy Bay toward the farther shore, until they are lost to view among a cluster of islands. It may be further remarked that their course northeastward from the mouth of South Bay is less obstructed by islands than almost any near-by portion of Windy Bay.

From our camp, a mile or so distant, Caribou in bands of approximately the following numbers were observed using this crossing-place during the early part of June: June 1—7, 10, 18, 20, and several other bands of unrecorded size; June 2—10, 3, 7; June 3—4, 4, 10, 30, 70, and others; June 4—3, 40?; June 5—40, 50, 75; June 6—25; June 10—8. Of course many others must have passed while our attention was elsewhere engaged. In most cases my records indicate the time of day when the bands were crossing Windy Bay.

The periods were mainly from 10 to 11 a.m., from 2:30 to 5 p.m., and in the evening. Perhaps the infrequency of midday passages was due to the habit of the Caribou of resting at this period. One of the last bands to pass during the evening of June 1 consisted of about 20 individuals. Two big bucks were in the lead, and apparently a few others were scattered along the line. At the very rear was a big, extra-dark buck, immediately preceded by a yearling barely half its size.

In crossing the bay ice, the animals traveled habitually in long files, one after the other, and yet not altogether in single file. In watching the endlessly interesting spectacle from camp, we could not always count the individuals exactly, for here and there a few would get abreast of others and be partly concealed. The general formation of each band was that of a much strung-out procession. For the most part the animals progressed at a moderate walking gait; there were no flies to spur them on at this season. On one occasion the forward element of a large band was actually running, but those in the rear were going calmly, and there was no visible cause of alarm. At mid-morning of June 6 most of a band of 25 were lying down to rest on the bay ice, while a few remained standing.

Meanwhile Caribou in some numbers were advancing northward by crossing Windy River, the ice on which did not break up generally till June 14. On June 3, for example, as I peeped out of my tent at 4 a.m., there was a band of about 15 making a crossing a quarter of a mile above camp. Late in the afternoon several dozen did likewise close to the same place. At this period I did not get farther upstream to note how many might be passing there. On June 14, while the river ice was breaking up but while the bay ice was holding firm, two bucks moved about on the latter, just off the river's mouth. They appeared to be seeking a safe crossing. The smaller of the two almost invariably preceded, just as if it were aware that it would be less likely to break through than its companion. For the most part they walked rather sedately, but now and then took up a very leisurely trot. On the following day a dozen crossed Windy Bay at about the same place. These were the last ones seen on the ice in June. Though the ice remained on the bay for some days longer, it had evidently become unsafe.

Thereafter the Caribou obviously preferred the short passage of Windy River (no more than 50 or 60 yards wide in places) to a swim of half a mile or so across Windy Bay. So they appeared in

considerable numbers on the south bank of the river, reconnoitering for a suitable place to cross. Many were deterred by movements or sounds in our camp on the north bank, including the yelping invariably set up by the tethered Husky dogs whenever they would catch sight of Caribou; the latter would then be likely either to retreat behind the ridges or to pass upstream along the south bank. Along the half-mile extent of this bank visible from our camp, I noted the following making the passage of the river by swimming: June 18, a band of half a dozen; June 20, a band of three landing practically in our dooryard and about 14 crossing at the mouth; June 21, six crossing at the mouth; June 24, about 10 (mostly big bucks) landing just above the camp. On the morning of July 1 a buck swam across the bay just off the river's mouth, and a little later a band of about 11—the last seen on the spring migration—were trotting upstream along the south bank.

Various groups observed during June, principally on the south side of the bay and the river, furnished memorable spectacles. Besides resorting to open areas on the frozen lakes and rivers for their resting periods, the Caribou will also select some commanding hilltop for the same purpose. On June 3 a band of 75 appeared in midday on the summit of a rocky hill ("Caribou Knoll," map 1) rising to a height of some 150 feet on the far side of Windy River. While some kept on feeding, many of them lay down on snowbanks, apparently preferring these to the plentiful patches of bare ground, and doubtless passing the time by chewing their cuds. The velvet of the bucks' new antlers was plainly visible through field-glasses. In the variety of their attitudes on this rocky height the animals were disposed perhaps more like alpine Chamois than like the generally conceived masses of Caribou on the low Barrens. What a subject for a Millais!

It appears likely that the higher elevations may serve for the nocturnal rest as well as for a noonday siesta. During the evening of June 1, for instance, some 75 Caribou in a loose aggregation were feeding over the summit of Josie's Hill, beyond the junction of Windy and South bays. On June 20 I was enjoying a wonderfully clear and golden light that was cast on the imposing mass of this hill as the sun was setting at my back about 9 o'clock. The glory of that scene was enhanced by picking out with the naked eye, at a distance of a couple of miles, two separate bands of 12 to 15 Caribou making their way upward toward the broad, plateaulike summit. Meanwhile a lone Caribou was outlined against the sky on

one of the rocky ridges to the south. Might not these various movements have indicated a common urge to spend the semi-darkness of the Arctic summer night on some high, open area where a good lookout for Wolves could be kept?

About 2 p.m. on June 15, a herd, perhaps half a hundred strong, appeared on a ridge directly across the river from camp. The animals made a lovely spectacle as they stood for a time, despite certain human movements in camp. Then they moved off upstream. A couple of hours later about 15 Caribou were feeding quietly on the south bank. On the following morning a band of 20 were doing likewise in nearly the same place. Among them were a patriarchal buck (apparently the leader), several other bucks, various does (one with hard horns), and a large proportion of yearlings. The bucks in general were lighter in color—more buffy; the does and yearlings, a sort of smoke gray. They seemed to be feeding to some extent on the patches of crowberry and dwarf birch. Presently they trotted off upstream, almost but not quite in single file, for a couple marched out of line with the others.

On June 17 a band of about 20 appeared at a distance of 125 yards on the brow of a low hill near Stump Lake. Nearly all were big bucks, with velvety antlers up to about 20 inches in length. Perhaps three in the band were hornless—if not does, then young bucks that had very recently shed their antlers. Two of the bigger bucks were in the lead. At first the band came toward me, then went off at a tangent at a good pace, splashed across a little stream in a spirited action, and disappeared over the next ridge.

Out of several bands appearing on June 20 on the opposite side of the river, one of about 14 individuals came down the slope near the mouth, took to the water at once, and made for the north shore. A strong buck landed first, and farthest upstream; others did nearly as well, but some of the smaller animals were swept by the strong current down into the bay and probably landed beyond the point. On reaching the shore, and even some minutes afterward, several of the Caribou could be seen shaking the water from their fur in dog-like fashion.

On the morning of June 21 a dozen came to the ridge across the river, briefly inspected the camp, and retreated. In a short time they returned, four antlered bucks in the lead, and some hornless individuals in the rear (almost in a separate band). Three of the bucks stood side by side, looking long and earnestly at the camp,

while the others grazed. Finally dissatisfied with the prospect, they made off upstream.

A little before 7 p.m. on the same day six Caribou appeared on the same ridge. For once the dogs were inattentive and silent. After promenading back and forth along the brow, the Caribou disappeared on the far side of the ridge; but in a few moments they were in the water at the river's mouth, in very close formation, three of them swimming abreast. There were three good bucks and three smaller, hornless animals. After they got ashore at the opposite point, there was wagging of tails and shaking of ears, heads, and bodies, while the water flew off in a spray. Then they leisurely proceeded along the shore and around the point.

About 7 p.m. on June 24 some 10 Caribou (mostly big bucks) swam the river and landed immediately above our camp. The last two, I noted, were heading almost upstream in the current that was running 6-8 miles per hour. They swam high, with the whole line of the back 2 or 3 inches out of the water and with the antlers tilted back to keep the snout above the surface. On landing, the animals hastened to the top of the Camp Ridge and ran off along it, while the chained and frustrated dogs expressed their feelings in the usual manner.

As I was retiring to my tent on the Camp Ridge in the twilight about 11:30 p.m. on June 29, I noticed a Caribou in the opposite edge of the river, about 125 yards away. For the most part it stood in about a foot of water and kept watching upstream. After some minutes I moved closer, right along the skyline; I waved a white pillow at it and shouted several times, but still it would not leave. Eventually it did move a few feet back from the water's edge and there appeared to browse on some dwarf birches.

The next day, watching from Pile o' Rocks northwest of camp, I noticed three Caribou passing on a northeasterly course. They walked for the most part, but now and again trotted. They were two well-antlered bucks and a smaller individual with shorter horns. One of the former paused to graze in a green-sprouting sedge bog. It was perhaps such fresh summer vegetation that had helped to produce fat an inch thick on the haunches of an animal secured about this date.

The area near the western border of Keewatin, lying at some distance south of Dubawnt Lake and west of the upper Kazan River, does not appear to attract large numbers of Caribou. Just once, in May, Charles Schweder has found them crossing a lake

which he considered Dubawnt, but may have been Kamiluk. In his trapping excursions in that area he has found trails and other signs all along the way, indicating that the animals at least pass through on their migrations.

Summer interlude

After July 1 no more Caribou were seen about the Windy River for five weeks. From information supplied by Charles Schweder, it appears that virtually all of the animals desert the southern portion of the Barren Grounds at this season. Before dropping their fawns, the does pass on for an undetermined distance to the northward of that portion of the upper Kazan River lying immediately below Ennadai Lake. The rear guard of the northward migration seems to be composed mainly of bucks and a few barren does.

A general veil of mystery seems so far to have enshrouded most of the natal places (except the islands along the Arctic mainland coast) and the first few weeks in the life of the Caribou fawns.

Fall migration in the Nueltin Lake region

In former times the southward migration reached the Nueltin Lake region in July (*cf.* Downes, 1943: 203-237), sometimes as early as the middle of the month. Suddenly the time of arrival shifted to (early) August, and has so remained. In Charles Schweder's experience, the bucks nearly every year precede the does on the southward migration; this suggests that at least the majority of the bucks may not go so far north as the does. In a certain year the does actually appeared first in coming south. In normal years, according to Fred Schweder, Jr., the migration continues till October or November, by which time the animals have passed into the wooded country for the winter.

Charles Schweder described the general pattern of fall migration as follows. At first two or three animals will appear, then a few more, and after several days a big movement, lasting three or four days, will pass through. Thereafter the numbers dwindle, though the migration continues. Curiously enough, there is a definite retrograde movement northward into the Barrens in September—sometimes as early as the first part of the month. Then there is a final movement toward the south in November, at the time of the first good snows; the largest herds of the year may then be seen. Just how far the migration in 1947 conformed to this pattern (outlined in early August) will be seen in the following pages.

The big August movement occurs occasionally as early as the first days of the month, whereas it was delayed till the last week in 1947. About the first of August, 1943, according to Fred Schweder, Jr., a thousand Caribou swam across the mouth of Windy River in the course of an hour, and there were other thousands during a two weeks' period. But such a large migration strikes this point only once in several years. In other years it may pass southward farther to the west, as in the vicinity of Simons' Lake.

In the fall of 1946—the very season when the Caribou bypassed the Eskimo camps on the upper Kazan River—there were said to have been far more than the normal numbers in the Windy River area. Thousands passed in one day, about October 10. The hills about Four-hill Creek then gave Fred Schweder, Jr., the impression of "moving with Deer." By comparison, the numbers along the Windy River in 1947 were considered by the local residents to have been below normal, however impressive they may have been to a zoological visitor. On the other hand, it seemed to Charles Schweder, during his trip down the Thlewiaza River in late August of 1947, that Caribou were still very numerous; and he reported that people along the west coast of Hudson Bay were then getting more of the animals than in previous years.

Only rarely do limited numbers of Caribou remain all winter in the Windy River area. During Charles Schweder's years of residence there (about 1936-47) the animals had done so just once—on the Windy Hills. In 1946-47 Fred Schweder, Jr., found about 300 of them remaining all winter about the north end of Ennadai Lake. He said that the locally wintering animals are all bucks. Katello, an elderly Eskimo of the upper Kazan River, informed Charles Schweder that the Caribou used to remain there all winter, but now very rarely do so.

By the end of July, after both men and dogs had subsisted for several weeks on a diet devoid of caribou meat, an air of expectancy began to pervade the Windy River camp. The hunters roamed the Barrens or watched from some lookout post such as the Pile o' Rocks (fig. 27). No Caribou were detected during plane trips to the upper Kazan River and return on July 31 and August 3, though their ancient, well-marked trails were visible along the ridges. It was not until August 6 that the first buck of the return movement was encountered. On the following day another animal was secured. On August 10 and 11 only a few Caribou—not over 25 in a band—were seen by Charles Schweder and Fred Schweder, Jr.,

from the air between the Windy and the Kazan rivers. It began to be feared that the bulk of the migration might pass somewhere to the westward. On August 13, however, at a distance of some miles from camp, Fred sighted 20 Caribou; all of them were does and fawns except for one buck. On August 17 he secured a good-sized buck (specimen No. 1065; figs. 3, 4) at Bear Slough and saw five other bucks elsewhere. Two days later Anoteelik reported a band of 13.

On August 20 Fred reported about 300 Caribou moving in our direction across the Barrens east of Lake Charles; they proved to be the advance guard of a big movement. On the same afternoon I had filmed several bucks going their separate ways on the slopes about Pile o' Rocks and Stony Man. They were moving along somewhat hurriedly, in a manner very different from the placid grazing of sheep or cattle. One or two does with fawns also appeared in the vicinity. (The passage of a Keewatin Tundra Wolf over the same ground a short time previously had no effect, as far as I observed, on the behavior of the animals at this time.) A grander, though more distant, spectacle gradually unfolded off to the eastward, beyond Little River, where several groups, numbering from 3 to 20 or 25 individuals, were feeding quietly over the open Barrens. Their fresh dark autumn coats showed up much more conspicuously than had the cream-buff of their winter coats in June. Presently the scene became livelier, as the largest band, composed of does and fawns as well as lordly bucks, started to romp northward over the Barrens. One or more of the various kinds of insects that bring life-long misery to the Caribou may have stampeded them. This band swept past a group of half its size without at once involving it. A doe and a fawn remained lying down as the others passed.

As the eye swept farther over that lonely land, still other Caribou were disclosed singly or in groups scattered over a couple of square miles. There was no strong herd instinct as they grazed at will. Even when on the march, they straggled along, some as much as 20 to 30 yards apart. As the sun sank lower, and the black flies became less active with the dropping temperature (about 53°), a lull ensued in the movements of the Caribou.

The big movement of the fall migration finally began to materialize on Sunday, August 24. This and the next few days were filled with memorable experiences. The throngs of Caribou passing at such times around the head of Windy Bay and across the lower-

most portions of Little and Windy rivers may be accounted for, in part, by the local topography (map 1). The upper part of Windy Bay, occupied by numerous islands of various sizes and extending about 5 miles in an east-west direction, opposes something of a barrier to the Caribou in their southward trek. The easiest way to overcome this barrier is to by-pass it. So the migrant herds approaching the north shore of the bay turn westward toward Little River. At a point half a mile short of this stream a rather minor proportion of the Caribou actually do essay a passage of Windy Bay. They cross an island lying very close to the north shore, then steer for a small rocky islet a quarter of a mile northwest of the mouth of South Bay. Here they get a brief respite from swimming by walking through the shallow bordering waters, then continue straight on to the rugged south shore of Windy Bay. This course is roughly parallel to, and a quarter of a mile west of, the one pursued northward or northeastward across the ice in the spring migration. The Caribou were seen to follow this water route on various days from August 24 to September 8, and again on October 7. Like the one across the ice, it is probably a regular, well-established, annual route.

The greater number of the migrants proceed along the north shore of the bay to Little River and are there confronted with a choice of various further routes. Some continue for an indefinite distance up the northeastern bank, passing Lake Charles on their right, though other animals, coming from the north, may be following this bank in the opposite direction. Probably most of the Caribou arriving from the eastward either plunge into Little River at its mouth and swim across (figs. 9, 10, 12) or pass upstream for a bare quarter of a mile and then wade across at a rapid (figs. 7, 8).

Without human interference, a large proportion of those that cross the lower part of Little River would doubtless proceed more or less directly to Windy River and cross near its mouth. But the human and canine inhabitants of the Windy River post seem to exert a strong influence in deflecting the Caribou northwestward along several more or less parallel ridges that rise to a maximum height of 40 or 50 feet. These are Little River, Middle, and Camp ridges (map 1). Many animals follow the first of these to its northwestern end, then cross a bog and ascend the Middle Ridge. Some cross the southeastern end of Little River Ridge, scramble down its steep sides by strongly marked trails (fig. 2), and then

move across the Eastern Bog to the Middle Ridge. But when they reach the summit, they can see the post directly ahead, and generally hurry off northwestward along the ridge. Presently some may cross the Camp Slough (fig. 13) to the Camp Ridge and then proceed either westward or northwestward. The Caribou have a strong predilection for following the treeless summits of the ridges wherever they are available and extend in a more or less desirable direction. On reaching the vicinity of the Bear Slough, where the three ridges are interrupted or peter out, the animals doubtless turn more or less southwestward to make a passage of Windy River at various points above its mouth. Under the conditions outlined above, it is obvious that some of the finest opportunities for close-range observation and photography lie at the two well-established crossings near the mouth of Little River.

On the dark and drizzly morning of August 24 (temp. 47°-48°) I noticed a number of Caribou, in groups of 2 to 20, traveling northwestward along Middle and Little River ridges. This indication of general activity enticed me to the top of the latter, whence I had a view of perhaps 8 or 10 animals scattered over the Barrens beyond Little River. Several were lying down just beyond the summit of a ridge between the river and Glacier Pond, so that little more than their antlers was visible. With the idea of finding out how closely I could approach these resting animals, I waded knee-deep across a rapid about 100 feet in width, and worked my way up the opposite slope until I once more caught sight of the tips of several antlers. Under cover of a rock and some dwarf birches, I crept ahead on hands and knees, with a miniature camera at the ready. I had arrived within 50 yards when the nearest buck got to its feet and stood looking at me. In hopes of photographing the rest while they were still lying down, I rose to my knees and hastily exposed the last bit of film in the camera. Still there was no immediate reaction on the part of the Caribou. Fortunately there was a cross wind. The first buck was so little alarmed that it leisurely sprinkled the ground. But presently it turned and walked off, presumably giving some signal of voice or posture (such as an erect tail) to the rest; for they got to their feet, not the half a dozen I expected, but half a hundred of them! Though they trotted off toward Windy Bay, they paused within a hundred yards and turned to stare at me. Several more relieved themselves as the first buck had done. By this time I saw that some of the Caribou, including a little fawn, were carrying their tails quite erect, as an expression

of suspicion or a signal of alarm. Evidently a majority of the band were bucks, but there were some does, with foot-long horns, and their fawns. On my way back to camp I noticed several groups of Caribou swimming across Windy Bay; perhaps they included the very animals I had so recently disturbed.

In the early afternoon it became evident that a further northwesterly movement was under way along the ridges between camp and Little River. The animals had doubtless made the passage of the river near its mouth. I followed some of them to a bog at the upper end of Little River Ridge, where I began to film several bucks and a lone, inquisitive, one-horned doe. While the latter was approaching me within a hundred feet, I caught a movement out of the corner of my eye, and all at once the bog seemed full of Caribou. There were 75-100 of them, chiefly bucks, and not more than 50 yards or so distant across the open bog. They presently moved on, without haste, and ascended the Middle Ridge.

Several hours later about 50 more Caribou passed through this bog. Then a band of 17 came along, composed chiefly of does and their fawns, with a couple of young bucks; they did not even turn their heads in my direction as I stood in the open 50 yards away. Eventually a herd of about 150 (the largest I saw during the whole season) passed along the well-worn trails on the summit of the Middle Ridge. It seemed to include all sexes and ages, with possibly a majority of does and fawns; bringing up the rear was a limping patriarch with huge antlers, a heavy mane, and a lingering winter coat.

During the remainder of the afternoon several other groups appeared in that general area. About 15 individuals descended Little River Ridge (fig. 2) to the Eastern Bog, but retraced their course after coming close to several of us; they were mostly does, with four fawns and a few bucks. Another band, of all ages and sexes and numbering perhaps a hundred individuals, crossed at the rapid on Little River. The temperatures that had prevailed during this day's marked migratory movements varied from about 45° to 50°. They were low enough to keep the black flies completely in abeyance, and the mosquito season was virtually over. Although I noticed none of the parasitic flies, possibly enough of them were present to keep the Caribou moving actively against a moderate to brisk northerly wind. Now and again a big buck could be seen fairly jumping out of its skin with the vigor of vibrating its sides to shake off the tormentors.

On August 25 (the second day of the big movement) I watched and filmed the pageant of Caribou migration from the southwestern bank of Little River. The turfy slopes of the Barrens, carpeted with low ericaceous shrubs, mosses, and reindeer lichens, and dotted here and there with little thickets of dwarf birch, spruce, and tamarack, stretched invitingly before me. Temperatures ranging from 40° to 51°, with a brisk northwest breeze sweeping down the river, happily suppressed most of the black flies.

The Caribou came along at intervals from the eastward, in bands up to 75 strong, either to make the passage of the river or to continue upstream along the opposite ridge. A small number might make the crossing in one or two files, but one of the larger bands might spread out widely in the shallow rapid. One of the photographs (fig. 7) shows approximately 75 Caribou going divergent ways at this rapid: about 20 passing upstream along the ridge on the far side, including some pausing to feed on the low vegetation; 8 or 9 moving down the slope of the ridge to the water's edge; about 10 bucks, 16 does, and 6 fawns making the passage of the river; and about 13 arriving on the near shore and pausing to feed. The adults were able to step across in the swift water, while the fawns swam part of the way. The bucks were apparently in the minority again on this day.

One group of some 40 does and fawns, after swimming the river near its mouth, came hurrying along the ridge in close array directly toward my station, and did not take alarm until they had arrived within 100 feet. Then they turned tail and, each with its flag erect, beat a hasty retreat. The maneuver made a scene of considerable charm and interest. While I was filming a dozen Caribou in the Eastern Bog from the Middle Ridge, a stray fawn came up and halted for some seconds within a rod of me. The bewildered look in its big eyes was comical though pathetic. In presently dashing on, it passed within a dozen feet.

Late in the afternoon Fred Schweder, Jr., reported about a thousand Caribou, in various bands up to 100 strong, crossing Little River here and there a mile or so above its mouth. They were traveling southwest.

August 26 was marked by mist squalls, a maximum temperature of 45°, and a slackening in the numbers of passing Caribou. Late in the morning a band of more than 30 bucks, does, and fawns crossed the rapid on Little River. In the early afternoon scattering individuals and a band of 15 or 20 did likewise. Presently another band of about 22 animals came (fig. 8); it consisted chiefly of does and fawns, but there were several medium-sized bucks bring-

ing up the rear. They crossed the rapid in a somewhat V-shaped formation, open at the front. The vanguard reached a rocky strip 25 yards in front of my camera and began to feed contentedly on the low vegetation. However, a couple of does still in the water eyed me intently and presumably communicated their misgivings to the others, for all turned and went back through the river without panic or haste, although they trotted on reaching the farther shore. Later there were about 25 Caribou crossing the bay, and nearly as many on Little River Ridge.

The weather on August 27, while mostly sunny, included occasional snow or sleet flurries; the northerly wind was brisk to strong; and the temperature, ranging from 37° to 50°, prevented the appearance of black flies. By 10:20 a.m. a band of about 10 does and fawns crossed the rapid on Little River. Two hours later 12-15 animals followed the same course, and presently 75-100 passed upstream on the far side, with a good deal of grunting. About 2:35 p.m. nearly a hundred Caribou, perhaps alarmed by a passing plane, dashed north out of the Eastern Bog. By 4:45 p.m. 20 or more bucks, does, and fawns swam across Little River at its mouth; several of the biggest bucks, with enormous antlers, led the advance into the water. An hour later, on the eastern side of the river, half a dozen of the animals were lying down, but with heads erect, and facing down wind. At this period of the day several more bands of moderate size swam over to the west side of the river. A goodly number of the animals fed within 25 yards of me for a considerable time.

The following day was nearly cloudless; wind moderate, westerly; temperature, 37.5° to 66°—high enough to bring out the black flies (but extremely few mosquitoes) after several days of virtual freedom from these scourges. Between 11:30 a.m. and 3 p.m. at least 500 Caribou, coming from the east, must have passed the mouth of Little River, some swimming across at that point (figs. 9, 12), and others proceeding various distances upstream before undertaking the passage. A few of the larger bands numbered approximately 30, 40, and 75 individuals. Some consisted largely of does and fawns, some of big bucks. One of the larger bands approached the river on the run, plunged in recklessly, and landed on the western shore some 30 feet directly in front of my battery of cameras. Most of the animals on this and similar occasions were remarkably indifferent to me as I operated the cameras in full view of them. Some among them would approach within a rod or less and stare me in the face without alarm (figs. 11, 14).

August 29 was a cloudy, nearly calm day, with temperatures ranging from 49.5° to 73°—conditions more propitious for black flies than for their victims. There was comparatively little local movement among the Caribou—in the morning two or three swimming across the bay and a band of 20 (6 old bucks, the rest does and fawns) swimming south across the mouth of Windy River; in mid-afternon a band of 10 running along the ridge on the eastern side of Little River; and about 100 reported during the day in the vicinity of Windy Bay by Fred Schweder, Jr. The "big movement" had passed its peak.

The next day was largely sunny, with a light easterly or southeasterly wind and temperatures of 50° to 68°. There were comparatively few black flies and fewer mosquitoes. During a five-hour vigil near the mouth of Little River I noticed only about 50 Caribou, most of them passing westward by

ones, twos, and intermediate numbers up to 17 (does and fawns) in a band. Mike Schweder reported a total of about 200 animals seen within a few miles of camp.

The morning of August 31 was dismal and overcast, with a heavy shower; in the afternoon the sky cleared; wind brisk, south to west; temperature, 47° to 74.5°. Several Caribou passed along the eastern side of Little River, and Fred Schweder, Jr., reported about 300 some miles north of camp, moving in a southwesterly direction.

Clouds and rain ushered in the morning of September 1; the afternoon was sunny; wind light to strong, west to northwest; temperature, 48° to 60°. The next day was partly cloudy, with a mist squall or two; wind light to brisk, northwesterly; temperature, 38° to 51.5°. No Caribou were reported on either day.

September 3 was largely cloudy, with some mist squalls; wind light to moderate, northerly to easterly; temperature, 40° to 51°. There were enough black flies to be slightly troublesome. Two bucks, two does, and a fawn were noted at Bear Slough.

September 4 was partly cloudy, with drizzling rain; wind light, east to south and southwest; temperature, 43° to 58°. I saw about 22 Caribou (largely does and fawns), in several different groups, at Bear Slough and vicinity, and Fred Schweder, Jr., reported about 200 in the same area. Two were noted swimming to the south side of Windy Bay.

September 5 was marked by a driving, day-long rainstorm; wind brisk, easterly; temperature, 43° to 50°. A band of about 20 Caribou (mostly does and fawns, with several middle-aged bucks), besides one or two single animals, were encountered at Bear Slough.

September 6 was a cloudy, raw day, with several snow flurries; wind brisk, northerly; temperature, 33° to 35°. Not a fly was abroad. Two Caribou moved northwest along Little River Ridge; a band of about 75 (mainly does and fawns, but with a fair number of big bucks) passed in the same direction along the Middle Ridge; and about 25 others grazed along the eastern side of Little River. Later about 15-20 more were seen about the mouth of Little River and on a near-by island, and eight swam across Windy Bay to the south side. Fred reported seeing about 300 during the day north and west of camp; they were moving in a northerly direction.

It was cloudy nearly all day on September 7; wind moderate, northerly; temperature, 33° to 40°. No black flies were in evidence. A dozen or more Caribou took to the water from an island in Windy Bay and made for the north shore. A band of about 25 passed along Little River Ridge toward the river's mouth.

September 8 was mostly cloudy; wind moderate to strong, southeasterly; temperature, 37° to 42°. Fred reported a band of about 100 Caribou crossing the mouth of Little River toward the west. A dozen or more swam southward over Windy Bay at the usual crossing-place. Anoteelik brought in 13 tongues from that many freshly killed Caribou; he had secured them with a .22 rifle.

A driving gale from the east, with rain and sleet, continued through the day on September 9; temperature, 36° to 37°. A solitary buck inspected our camp from the south side of Windy River, then retreated.

An overcast sky, with some drizzle and sleet, prevailed on September 10;

wind light, east to northeast; temperature, 35.5° to 42.5°. No flies present for some days past. Fred reported about 20 Caribou moving westward in the vicinity of Little River.

On September 11 clouds and mist squalls in the morning gave way to sunshine in the afternoon; wind light, easterly; temperature, 37° to 45.5°. Caribou were noted as follows: five on the east side of Little River; two does and a fawn on an island in Windy Bay; a doe and a fawn swimming northward across this bay; half a dozen on Josie's Hill. During a flight from Churchill to Nueltin Lake on this day, Charles Schweder detected no Caribou at all, and concluded that the bulk of the migrating herds had by this time passed to the southward of his course. During the latter part of August, while descending the Thlewiaza River from Nueltin Lake to Hudson Bay, he had seen thousands of the animals—as many as 5,000 in a single day, although no more than 500 in a single herd.

Sun, clouds, and rain marked September 12; wind moderate to light, south to west; temperature, 48° to 60°. Only two Caribou were reported.

September 13 was cloudy, with intermittent mist squalls and a little sun; wind light to brisk, northerly: temperature, 34° to about 44°. Two bands of Caribou (of four and five animals) appeared near the mouth of Windy River.

It was generally cloudy, with a snow squall, on September 14; wind brisk to light, northerly; temperature, 33° to 41°. A doe and a fawn, proceeding northward, and four or five other Caribou appeared on the near-by ridges.

The weather was clear on the 15th, with a moderate to brisk north wind and temperatures of 29° to 48°; ice at edge of the river. Fred reported about 100 Caribou (none of them bucks) north of camp, and Anoteelik secured 13 east of Little River.

On the morning of the 16th intermittent snow flurries left a thin cover on the ground, but it was practically dissipated by the afternoon sun; wind brisk, northerly; temperature, 30° to 39°. Fred reported three old does without fawns, and no bucks.

September 17 was mostly cloudy, with a little sun; wind light, northwest and west; temperature, 30° to 43°. A single Caribou was seen on the south side of Windy River.

Clear skies prevailed on September 18; wind brisk, westerly; temperature, 35° to 53.5°; ice at edge of the river. A solitary black fly appeared. No Caribou reported.

September 19 was another clear day; wind moderate to brisk, west-southwest; temperature, 42° to 60°. Anoteelik, camping on the Barrens about 2 miles to the north of camp for the past couple of days, reports having killed 20 Caribou (only one of them a buck).

Light rain, soon changing to sleet, and then frequent snow squalls, provided the principal weather elements on September 20; wind light to strong, west to north; temperature, 27° to 43.5°. The ground became partly covered with snow. A big buck, followed several hours later by a doe and a fawn, swam across to the north side of Windy River at its mouth. Ten more Caribou were taken by Anoteelik. Charles considered that the retrograde movement to the north was definitely under way. There had been indications of it on various days from September 6 on.

Except for a few snow flurries, it was largely sunny on the 21st; wind brisk to moderate, north to northwest; temperature, 26° to 34°. About a quarter of an inch of snow remained in sheltered places. A doe and a fawn appeared near camp.

There was considerable snowfall on the 22nd; wind light to moderate, westerly; temperature, 30° to 33°; ice in edge of the river. A large buck left tracks in the snow along the Windy River.

September 23 was partly cloudy; wind brisk, north-northwest; temperature, 21° to 32°; about a quarter of an inch of snow on the ground, and a tundra pond mostly frozen over. Several small groups of Caribou (a doe and a fawn; three does and two fawns; and three others) appeared on the near-by ridges.

September 24 was mostly cloudy; wind moderate to brisk, northerly; temperature, 26° to 41°; nearly an inch of fresh snow on the ground. About 15 does and fawns were resting or feeding quietly on the east side of Little River, and tracks of about half a dozen were noted on Camp Ridge. Charles Schweder reported about 50 Caribou, in three slightly separated bands, appearing during the evening on the south side of Windy River about 2 miles above its mouth, as if contemplating a crossing. He thought they may have been alarmed by Wolves.

September 25 was a cloudy day; wind moderate to light, northerly to westerly; temperature, 31° to 36°; open ground largely bare by afternoon; ice forming on Windy Bay. Some Caribou tracks were noted on the north side of Windy River.

There were clouds, a sprinkle or two of rain, and a little sunshine on the 26th; wind brisk to moderate, southwest to west; temperature, 36° to 47.5°; ground becoming practically bare. Three Caribou were seen beyond Little River, and a doe and a fawn on the south side of Windy River.

The 27th was mostly cloudy, with a thick snow flurry; wind brisk, northwest; temperature, 33° to 40°. Two tundra ponds, previously frozen, were mostly open. Three bucks, a doe, and a fawn were noted on the south side of Windy River.

September 28 was mostly cloudy; wind brisk to light, north-northwest; temperature, 28.5° to 40°; a little snow on the ground disappearing. Seven large bucks (six in one band, moving northward) passed over Camp Ridge, and a dozen other Caribou (including does) were seen beyond Little River.

The 29th was chiefly sunny; wind very light to brisk, west to southwest; temperature, 29° to 48°; ground bare. A band of about 15 Caribou appeared on the north side of Windy River at its mouth. They included four large and two smaller bucks, the remainder being does and fawns. They were apparently traveling south.

The 30th was cloudy, with a sprinkle of rain; wind light, westerly; temperature, 39° to 48°; ground bare. A few black flies were brought out by the mild weather. During an all-morning trip to Point Lake, Charles saw no Caribou, but in the afternoon he reported about 200 on the eastern side of Little River. There were also half a dozen bucks on the south side of Windy River.

October 1 was a rare, fine, sunshiny day in the Barrens; wind moderate

to brisk, south to southwest; temperature, 37° to 61°; ground bare; tundra ponds mostly ice-covered. A blowfly crawled over a caribou carcass, and possibly a few black flies were abroad. Two bucks passed from the shoal water of Duck Bay over Little River Ridge. Charles reported about 40 Caribou moving north a mile or two north of camp, and I saw a single buck likewise engaged. During the preceding week or so Fred had seen a good many of the animals between the upper Kazan River and Nueltin Lake; they were moving south and west.

The 2nd was another clear day; wind moderate, southwest; temperature, 41° to 65°; ground bare. About five does and fawns were seen at dusk in the spruce tract near Four-hill Creek.

The next day was drizzly and foggy throughout; wind light, southwest to southeast; temperature, 41° to 43.5°. No Caribou sighted. Eskimos arriving in camp reported them scarce along the way from the upper Kazan River.

October 4 was a dismal, dark day, with steady light rain throughout; wind very light, easterly; temperature, 36° to 42.5°. Fred reported 20 Caribou north of camp.

Snow fell throughout the 5th; wind light, north-northwest; temperature, 31° to 35°. No Caribou sighted.

With 6 inches of snow on the ground in the morning, there was some additional precipitation during the overcast day of October 6; wind moderate to brisk, northeast; temperature, 31° to 33°; waters clear of ice. No Caribou sighted.

October 7 was a generally cloudy day; wind moderate to very light, northerly; temperature, 24° to 29°; watercourses largely open. In the morning Charles reported a couple of hundred Caribou swimming southward across Windy Bay; he considered this a part of the final southward movement into the timbered country—apparently initiated by the recent snowstorm. Later he saw an approximately equal number 2 miles north of camp, moving toward the bay; and Fred encountered about 50 on the north side of the bay.

Late on the 8th clouds gave way to sunshine; nearly calm to a gentle breeze from west and southwest; temperature, 26.5° to 33.5°; 6 inches of snow on ground. I obtained a distant view of about 100 Caribou resting near Glacier Pond. Perhaps less than a quarter of them were old bucks; the remainder, younger bucks, does, and fawns.

October 9 was largely sunny, with light rain in the evening; wind light to moderate, southwest to south; temperature, 29° to 38°; ground with a 6-inch snow covering. No Caribou sighted.

Some snow fell on the 10th, though the day was partly sunny; wind very light, south to west; temperature, 33° to 36°. No Caribou sighted.

Clouds prevailed on the 11th; wind no more than very light, westerly; temperature, 33° to 38°; about 4 inches of snow on ground. Charles reported about a thousand Caribou scattered over a long hill several miles to the northwest; they were not traveling.

October 12 was marked by clouds, mist, and rain; wind light to moderate, southwesterly; temperature, 32° to 40°. No Caribou sighted.

There was a little sun on the 13th; wind light to moderate, west to

east; temperature, 37° to 45.5°; ground largely bare and tundra ponds open. In the afternoon we set out for Simons' Lake, and camped about 4 miles up the Windy River. No Caribou sighted.

On the 14th we reached the upper end of Simons' Lake, for a several days' stay at a deserted trading-post. There were snow flurries and a little rain; wind brisk, westerly; temperature, 35° to 36°; ground mostly bare. A band of about 15 Caribou, a solitary buck, and many tracks and droppings were seen along the way.

October 15 was partly cloudy; wind very light to light, west to northwest and east; temperature, 21° to 36°. Four Caribou sighted.

October 16 was a stormy, cloudy day; wind brisk, easterly; temperature, 30.5° to 34°. About a dozen Caribou were noted in the vicinity of Simons' Lake.

A strong easterly gale during the night, with heavy rain, was followed during the day of the 17th by steady rain, with moderate to light easterly or southeasterly wind; temperature, 35° to 38°. A single Caribou seen.

October 18 was partly cloudy; wind brisk to light, westerly; temperature, 31° to 41°; waters open; some small patches of snow in sight. Four Caribou (at least two of them bucks) passed by.

The 19th was partly cloudy; nearly calm to moderate wind, west and northwest; temperature, 30° to 40°. About five or six bucks (three of them together) appeared, perhaps moving south.

The weather on the 20th was raw, dismal, and gusty; wind brisk, northwest; temperature, 27° to about 35°; some ice on Simons' Lake; a little fresh snow on higher hills. No Caribou sighted.

October 21 was somewhat foggy; nearly calm; temperature, 25° to 32°; Simons' Lake partly frozen; ground generally bare. A lone fawn was seen as we started on the return trip to the Windy River post.

The 22nd was largely sunny; wind very light to brisk, southwesterly; temperature, about 30° to 46°. A medium-sized buck was seen near the mouth of Windy River.

The 23rd was largely cloudy; wind brisk, southwest; temperature, 35° to 39°; ground practically all bare; bay and river open. A buck started to cross to the north side of Windy River, but went back.

For the better part of a week, till October 29, I found no further fresh indications of Caribou in our vicinity. In the meantime the weather was largely cloudy, with some rain and snow (4-5 inches of the latter on the 27th); winds very light to moderate, swinging from east to south and west; temperature, 27° to 50°; waters generally open.

October 29 was largely cloudy; a gentle wind, south to east; temperature, 29° to 35°; 4-5 inches of snow on ground; thin ice on a tundra pond. The fresh track of a buck (fig. 20) was found near camp.

On the 30th gentle rain changed to snow; calm to a moderate wind, northeast to north; temperature, 30° to 33°. Tracks showed the passing of about a dozen Caribou, including half a dozen that swam westward across the mouth of Little River, breaking through a rim of ice at the edge.

Clouds prevailed on the 31st; wind moderate to brisk, northerly; temperature, 17° to 25.5°; 5-6 inches of snow on ground, with drifts up to a foot deep; river and lake open. Fred reported three Caribou.

November 1 marked the long-delayed "freeze-up." Windy Bay and the edges of Windy River were frozen, while pieces of ice floated down the river. The day was cloudy, with continual snow flurries after noon; wind light to brisk, southeast; temperature, 21° to 31°; about 6 inches of snow on ground.

The 2nd was cloudy, with some rain and sleet; wind moderate to brisk, southeast to west; temperature, 29° to 34°. No Caribou sighted for two days.

On the 3rd it was cloudy all day; wind light, northwest; temperature, 16° to 20°. A herd of about 50 Caribou (largely does, with a few fawns and well-antlered bucks) hurried down the side of Little River Ridge onto the ice of Duck Bay, with the apparent intention of crossing to the south side of Windy Bay; but they were intercepted by a hunter and retreated northwestward along the ridge. Fred secured three southward-traveling bucks at a distance from camp.

No Caribou were sighted on the three following days (November 4 to 6), which were more or less cloudy, with some snow; wind light to brisk, southerly to northerly; temperature, 13° to 24.5°; ice 3 inches thick on Windy Bay; about 6 inches of snow on ground.

There was snow during the night of November 6 and the morning of the 7th, resulting in drifts up to a yard deep; wind brisk, northerly; temperature, −3° to 13°. Fred reported "lots" of Caribou some 10 miles to the north, moving south.

The next three days (November 8 to 10) varied from cloudy (with a snow flurry) to sunny; wind moderate to strong, northwest and north; temperature, −10.5° to 1°; 6-8 inches of snow (much drifted); Windy River gradually becoming ice-covered. No Caribou sighted.

November 11 was partly sunny; wind moderate to brisk, northerly; temperature, 3° to 6.5°; about 8 inches of snow on the average. Mike Schweder reported five does moving south across the mouth of Windy River on the ice.

Thereafter, until my departure on December 4, no more Caribou were actually seen in the vicinity of the headquarters on Windy River. There were, however, tracks of single animals on November 15 and 16. Moreover, during the period from about November 7 to 15, while traveling northward to the upper Kazan River, Charles Schweder saw thousands of Caribou, in herds up to 300, moving southward. He surmised that their course took them somewhere between Ennadai and Nueltin lakes. Fred also reported many to the northward on the 7th, as already noted. This was perhaps the last large migratory movement of the year in our general area. Thereafter virtually all of the animals were presumably in the timbered area to the southward. None was sighted from the plane during the flight to Churchill on December 4.

On November 7 the temperature had taken a sharp downward turn, dropping below zero for the first time that season; and it did not again rise above 6.5° till November 12. This cold spell, combined with a snow blizzard from the north on the 6th and 7th, coincided at least in part with the large migratory movement noted above, and it may have been the stimulus for it.

The general weather conditions that obtained from November 12 on

may be summarized as follows. It was at least predominantly cloudy on all but four or five days. There was snowfall on six days, and drifting snow in the air on several other days. The winds were predominantly north, northwest, and west; less commonly, east and southeast. They were a little more frequently light than moderate or brisk. The extremes of temperature during this period were 22.5° and −23°; the average daily mean, approximately 1°. There was an average of probably at least 8 inches of snow on the ground, with deeper drifts. The river was not wholly frozen over at least up to the end of November.

Retrograde autumnal movement

It would doubtless be difficult to find, among other animals, any exact parallel to this curious feature of caribou migration. According to Charles Schweder, it takes place in the Nueltin Lake region in September—sometimes as early as the first of the month. Herds up to 200 strong may then be seen moving northward, but generally the numbers are smaller—say 10 to 30 in a band. Some of the more notable autumnal movements toward the north, as reported by Charles, were the following: at Simons' Lake in 1936 and again in 1938, when herds of fat bucks were streaming past for a month and a half; likewise at Josie's Bay in 1940; and through the Windy Hills and across Windy River in 1943. Fred Schweder, Jr., said that most of the animals, in returning northward at this season, cross Windy River 4 miles above its mouth or Windy Bay 4 miles from its head; comparatively few pass the mouths of Windy and Little rivers. He remarked further that it is mostly bucks, with few does and fawns, that make the passage on Windy Bay.

More or less evidence of such a movement toward the north in 1947 has been presented in preceding pages, in the notes for September 6, 7, 11, 14, 20, 24, and 28, October 1, and even October 23. The numbers observed so involved on each of these days varied from a solitary buck or a doe with a fawn to about 300 of the animals. On some of these days, however, other Caribou were observed making their way toward the south. It is thus obvious that there was no universal impulse among the Caribou of a given area to move simultaneously in a certain direction.

The general weather conditions on the nine above-mentioned days may be summarized as follows. Every day but one was largely or wholly cloudy; snow falling on three days, but ground bare on other days; wind predominantly from the north; extreme temperatures, 26° and 61°; mean daily average, 37.5°. Whether or not there is significance in the matter, it appears that on those days within the period extending from September 6 to October 1, when

FIG. 1. Half a dozen caribou trails along the Middle Ridge, looking SE. Ground plants: *Ledum decumbens, Empetrum nigrum, Arctostaphylos alpina, Loiseleuria procumbens,* and various lichens, including *Cladonia.* A miniature "glacier" in the distance. June 24, 1947.

FIG. 2. Caribou trails on the 50-foot-high Little River Ridge. *Picea mariana, Betula glandulosa,* and *Empetrum nigrum.* June 19, 1947.

FIG. 3. A Caribou buck (specimen No. 1065) being skinned by Fred, Mike, and Rita at the Bear Slough. August 17, 1947.

FIG. 4. Skull, antlers, skin, and hind quarter of the same Caribou being transported to camp along the Camp Ridge. August 17, 1947.

FIG. 5. Anoteelik and Mike preparing to bring in a load of caribou meat with dogs and travois. Windy River post, August 19, 1947.

FIG. 6. Anoteelik and Mike pegging out caribou hides to dry on a gravelly ridge near the mouth of Windy River. August 23, 1947.

FIG. 7. About 75 Caribou (bucks, does, and fawns) at a rapid on Little River. August 25, 1947.

FIG. 8. About 22 Caribou crossing Little River at a rapid. Chiefly does and fawns, with several bucks bringing up the rear. August 26, 1947.

the Caribou were not definitely observed moving northward, the winds were less likely to be northerly. Furthermore, within this period there was never enough snow to interfere appreciably with the animals' feeding on the ground lichens of the Barrens.

By October 6 there were 6 inches of snow on the ground, and on the following day 200 Caribou swimming southward across Windy Bay may have marked the beginning of the final movement into the timbered country. It appears possible that a considerable fall of snow may have a definite influence in inducing the Caribou to retreat from the Barrens.

On a trip from Windy River north to the Kazan River region in September, 1946, Charles Schweder found, during the first 45 miles, that the Caribou were moving north; at the Kazan they were moving south, although some were merely loitering. Northwest of the Kazan, the animals were taking a westward course. During the latter part of his return trip to Windy River, 11 or 12 days later, they had reversed the previous direction and were traveling south.

For such a distinct and regular feature in the life cycle of the species as the retrograde autumnal movement there must be some biological explanation. Several possible factors appear reasonably clear. Perhaps we may consider the Barren Grounds the true and preferred home of *Rangifer arcticus*, from which a proportion of the population is driven during part of the year under stress of insect attacks or shortage of food. When the animals begin to enter the woods in August, there is no shortage of food; thus an insect-induced frenzy may possibly be regarded as a potent force driving them southward. In September a state of comparative peace descends upon the caribou world: the current crop of adult insects has subsided; the larvae of warble and nostril flies have not attained the formidable size of the following spring and perhaps are not yet causing any severe discomfort; little or no snow covers up the food supply; the lakes and rivers, still unfrozen, offer a ready way of escape from pursuing Wolves; moderate or even balmy weather gives nature a pleasant mood. In short, both man and beast may well look upon early autumn as the very finest time of year both on the Barrens and in the adjacent wooded country.

Under these circumstances a definite retrograde movement out of the wooded country in September on the part of many Caribou must indicate their preference for the Barrens at this season. In any event, the movement begins just after the insect menace has

subsided to a negligible stage. Possibly another inducement for retreating from the wooded country in the early fall is the dearth of open areas in which the animals may spend their resting periods, in comparative safety from Wolves. It is only after the freeze-up that the surfaces of the lakes and rivers supply this desideratum. This condition lasts from November to June—precisely that part of the year in which the Caribou are present in the wooded country in the greatest numbers.

But by November what are the conditions on the Barrens? The weather has become severe; snow has covered up a large part of the ground lichens; tree lichens are not to be had. And so at this season, with the coming of the first heavy snows, there is a final movement out of the Barrens into the shelter of the woods, leaving only a minority of the animals to face a bleak and bitter winter in the open country. The biggest herds of the year may then be seen passing southward. A few bucks are said to remain during most winters in the Windy River area.

Far to the westward, toward Great Slave and Great Bear lakes, the retrograde movements are somewhat different and more complicated (Clarke, 1940: 96).

"Mr. Carl Buchholz, of Churchill, describes the caribou migration at the 60th parallel, north of Churchill, as a southward migration in August, northward in September, and then south in the autumn" (Clarke, 1940: 97). (See also the next paragraph.)

Fall migration in the Churchill region

The following notes for 1947 were kindly furnished me by Angus MacIver. He reported large numbers of Caribou moving southward across Caribou Creek (25 miles south of Churchill) about November 10, a day after the local freeze-up. He would then see thousands in a day. Prior to that time (perhaps in September?) there had been two "runs" to the northward and northwestward; these presumably represented the normal retrograde migration in the fall. The herds engaged in these two northerly movements must have previously passed southward farther inland. He reported also that the rutting season this year had commenced a little later than the usual October 15.

References on migration.—Dobbs, 1774: 20, 22; Hearne, 1795: 39, 40, 56, 66, 74, 85-87, 286, 299; Franklin, 1823: 241-242; Sabine, in Franklin, 1823: 667; Richardson, "1825": 328-329, and 1829: 242-243; Godman, 1831, **2**: 283-284; John Ross, 1835*a*: 328, 330, 337, 376, 390, 529-530, 628; J. C. Ross, in John Ross, 1835*b*: xvii; Richardson, in Back, 1836: 498;

Simpson, 1843: 76, 196, 233, 277, 301, 320-321, 328, 386; Rae, 1850: 93; Richardson, 1852: 290, 296; Rae, 1852*a*: 79; J. Anderson, 1857: 326, 328; Murray, 1858: 203; Richardson, 1861: 274, 275; B. R. Ross, 1861: 438-439; Osborn, 1865: 223-224, 226; Kumlien, 1879: 54; R. Bell, 1881: 15C; Caton, 1881: 108; Gilder, 1881: 196-197; Nourse, 1884: 235, 356; Schwatka, 1885: 77-79, 83; Boas, 1888: 502; Collinson, 1889: 244, 290; Pike, 1917 (1892): 48-49, 50, 89-91, 101, 174, 204, 209, 220; J. B. Tyrrell, 1892: 128-130; Dowling, 1893: 103, 107; J. B. Tyrrell, 1894: 442, 1896: 13, 63, and 1897: 10, 19, 21, 49-50, 76, 124, 140, 142, 165; Russell, 1895: 48, and 1898: 88, 226; Whitney, 1896: 157, 238, 241; Lydekker, 1898: 48; J. W. Tyrrell, 1908 (1898): 77-78, 80; Jones, 1899: 368, 374; Hanbury, 1900: 66-67, 69, 71; A. J. Stone, 1900: 50, 53; W. J. McLean, 1901: 5, 6; Elliot, 1902: 259, 260, 274-275; Preble, 1902: 42; J. W. Tyrrell, 1924 (1902): 26, 31; Hanbury, 1904: 10, 30, 32, 34, 58, 93, 108, 120, 121, 139; Hornaday, 1904: 137; Stone and Cram, 1904: 52; MacFarlane, 1905: 683-685; J. A. Allen, 1908*a*: 490; Amundsen, 1908, **1**: 97, 102-106, 200, 247, 326-329; Preble, 1908: 137-139; Cameron, 1912: 127; Wheeler, 1912: 199-200; R. M. Anderson, 1913*a*: 6, and 1913 *b*: 502; Stefánsson, 1913*a*: 94-96, 99, 100, 103, 106, 1913*b*: 203-204, 224-225, 263-265, 269, 294, 348-350, and 1914: 39, 41, 54; Chambers, 1914: 93; Hornaday, 1914, **2**: 101-104; Wheeler, 1914: 58; Harper, 1915: 160; Camsell, 1916: 21; Thompson, 1916: 99-101; Kindle, 1917: 107-108; Camsell and Malcolm, 1919: 46; Whittaker, 1919: 166-167; Buchanan, 1920: 105-108, 128-129; Hewitt, 1921: 60-63; Stefánsson, 1921: 401; Jenness, 1922: 15, 17, 25-26, 125; Blanchet, 1925: 32-34, and 1926*b*: 46-48; Mallet, 1926: 79; Preble, 1926: 137-138; Rasmussen, 1927: 54, 214-217, 246; Birket-Smith, 1929 (1): 51, 56, 101, 106; Seton, 1929, **3**: 122, 125-128; Blanchet, 1930: 49-52; Critchell-Bullock, 1930: 58, 192-196; Hoare, 1930: 13, 14, 16, 21, 22, 27, 31, 33, 36-38; Kitto, 1930: 87; Mallet, 1930: 20-23, 27; Jacobi, 1931: 80-84, 192-210; Harper, 1932: 30, 31; Munn, 1932: 58; Sutton and Hamilton, 1932: 79, 81; Weyer, 1932: 40; Birket-Smith, 1933: 91-94, 112, 118; Ingstad, 1933: 34, 134-135, 156-159, 161, 163, 225, 229-231, 280, 291, 293, 296, 324; Weeks, 1933: 65; R. M. Anderson, 1934*a*: 81, 1937: 103, and 1938: 400; Hornby, 1934: 105-107; Birket-Smith, 1936: 91; Hamilton, 1939: 244-247, 359; Murie, 1939: 244; Clarke, 1940: 8-9, 11, 85-100; G. M. Allen, 1942: 298-299; Soper, 1942: 143; Downes, 1943: 215, 221, 224, 249, 250, 253-256, 260; Manning, 1943*a*: 52, and 1943*b*: 103; Porsild, 1943: 389; Soper, 1944: 248-249; Wright, 1944: 186, 190; Gavin, 1945: 227-228; R. M. Anderson, 1947: 178, and 1948: 15; Manning, 1948: 26-28; Rand, 1948*a*: 212, and 1948*b*: 149; Banfield, 1949: 478, 481; Harper, 1949: 226-230, 239-240; Banfield, 1951*a*: 6, 9-12, 28, and 1951*b*: 120; Anonymous, 1952: 267; Barnett, 1954: 96, 103.

Summation of Geographical Distribution

The localities from which hitherto unpublished notes on *Rangifer arcticus arcticus* are presented in this paper include the following. Keewatin: Nueltin, Windy, "Highway" (at source of Putahow River), and Ennadai lakes; Little Dubawnt, Kazan, Red, Windy, Little, and Thlewiaza rivers; between Eskimo Point and Baker Lake. Manitoba: Nueltin (southern part), Nejanilini, Reindeer, and Split lakes; Seal River; Churchill; Cape Churchill; "Little Barrens" south of Churchill; between Churchill and Knife Lake; Caribou Creek, 25 miles south of Churchill. Saskatchewan: small lakes southwest of Reindeer Lake; lakes south of Lake Athabaska. De-

tails as to occurrence and status in these localities are supplied on other pages.

The Caribou have been so thoroughly distributed over the approximately 300,000 square miles of the mainland Barren Grounds between Hudson Bay and the Mackenzie Valley that it is fairly safe to say that there is scarcely one square mile in this vast territory that has not been trod by the animals during the past century. See maps by Preble (1908: pl. 19), Seton (1929, **3**: 60), Clarke (1940: figs. 3, 4), Banfield (1949: 479), and Anonymous (1952: 267).

The appended annotated bibliography supplies, in abstract form, most of the hitherto published information on the geographical distribution of *Rangifer arcticus arcticus*. In its preparation I have included records of Caribou from the Arctic islands north to Lancaster Sound, Barrow Strait, Viscount Melville Sound, and McClure Strait—all approximately in latitude 74° N. This has been done as a matter of having a convenient, well-defined regional boundary, not with any conviction that *arcticus* has ranged so far to the north in the more westerly islands, especially in recent years, when it is said to have become restricted to the southern fringe of the islands (Clarke, 1940: 98; R. M. Anderson, 1947: 178; Banfield, 1949: fig. 1). The islands north of latitude 74° are doubtless the exclusive domain of *Rangifer pearyi*. It is possible that this species may also occur to some extent on Banks, Victoria, Prince of Wales, and Somerset islands. The typical *R. a. arcticus*, as currently recognized, ranges eastward to Baffin, Salisbury, Coats, and Southampton islands and to the western shore of Hudson Bay. (The animals of the last three islands may be distinct insular forms.) The southern limits of the winter range in northwestern Ontario, central Manitoba, northern Saskatchewan, and northeastern Alberta have been discussed in preceding pages. On the west the range extends to the Mackenzie Delta (formerly), Great Bear and Great Slave lakes, Wood Buffalo Park, and Lake Claire. The timbered country (Hudsonian and Canadian Zones) is practically entirely deserted by the Barren Ground Caribou in mid-summer. At this season, in Keewatin at least, the animals tend to draw away also from the southernmost portions of the Barren Grounds.

References.—Since practically every paper in the entire bibliography presents some data on geographical distribution, only a few, containing more than an average amount of new or summarized information on the subject, have been selected for inclusion in the following list of references: Hearne, 1795; Franklin, 1823; Lyon, 1824; Franklin and Richardson, 1828; Simpson, 1843; Pike, 1917 (1892); Russell, 1898; Preble, 1902; Hanbury, 1904; Amundsen, 1908: Preble, 1908; R. M. Anderson, in Stefánsson, 1913*b*; Stefánsson, 1913*a*, 1913*b*, and 1921; Hewitt, 1921; Jenness, 1922; Rasmussen, 1927; Seton, 1929, **3**; Blanchet, 1930; Critchell-Bullock, 1930; Hoare, 1930; Jacobi, 1931; Clarke, 1940; Manning, 1943*a*; Wright, 1944; R. M. Anderson, 1947; Manning, 1948; Banfield, 1949 and 1951*a*.

Distributional maps.—Grant, 1903: map following p. 196; Preble, 1908: pl. 19; Dugmore, 1913: 138; Hewitt, 1921: 57; Seton, 1929, **3**: 60, map 2; Jacobi, 1931: 77, fig. 17; R. M. Anderson, 1934*b*: 4062, fig. 6; Murie, 1939: 241; Clarke, 1940: figs. 3, 4; Banfield, 1949: 479, fig. 1, and 1951*a*: figs. 4-10; Anonymous, 1952: 267.

Ecology

Habitats

Within their natural range the Caribou apparently resort to practically every type of terrestrial and aquatic habitat (other than cliffs and precipices). On the Barren Grounds proper they frequent the open summits and slopes of the ridges, the dwarf birch thickets, the sedge bogs, and the peat bogs. Their trails traverse all the upland spruce and tamarack tracts, the wooded muskegs, and the willow thickets along the rivers. In the summer and fall they swim the rivers and the narrower lakes, and during the winter and spring they cross these on the ice. They do not avoid rapids; in fact, they seek the shallower ones as fords, and they swim the deeper ones (*cf.* Clarke, 1940: 88). They also cross the tundra ponds on the ice, but probably walk around these smaller bodies of water, as a rule, when they are not frozen. While they may prefer to approach the river crossings over open slopes, they do not hesitate to maintain trails through the dense thickets of willow on the banks.

The winter habitat of the major part of the Barren Ground Caribou population comprises the Hudsonian and upper Canadian Zones. This forested habitat is characterized by sparser and smaller timber in the Hudsonian Zone and by denser and taller timber in the Canadian Zone. Important among the features of this winter habitat are the frozen surfaces of the lakes and rivers, where the Caribou are wont to congregate for their daily periods of rest (*cf.* Mallet, 1926: 79; Ingstad, 1933: 86).

Trails

The favorite migratory highways are the long, sinuous ridges that stretch across the Barren Grounds in a sufficiently approximate north-south direction to serve the needs of the Caribou. Here their age-old trails are particularly in evidence and may even be detected from the air. A single small ridge may bear half a dozen or more such trails (fig. 1), roughly parallel but anastomosing at frequent intervals. They probably change but little from generation to generation. They provide the smoothest courses available, avoiding rocks and shrubs and traversing intervening bogs at the most suitable points. The summits of the ridges constitute vantage points from which the animals may keep a wide lookout for Wolves and human enemies, and on which they may obtain the maximum benefit from fly-deterring breezes. Man himself is glad to utilize these trails, whether on the Barrens or in the timber tracts, wherever they

lead in a direction he desires. They are kept open by the hurrying feet of hundreds or thousands of Caribou every year.

Along a well-used trail extending through low Barrens near Duck Bay, I found a certain grass (*Agrostis scabra*) growing. I did not recognize or collect it elsewhere during the season. Is this perhaps like certain other species, such as *Juncus tenuis* (*fide* Dr. Edgar T. Wherry) and *Eleocharis baldwinii,* in curiously thriving on beaten paths?

When the Caribou arrive at some lake or river, they generally follow the shores for a greater or lesser distance, seeking either a way around or a suitable crossing-place. The trails thus formed are generally on the nearest ridges rather than on the immediate shores. Their direction, as they conform to the winding shores, may diverge very widely from the desired migratory course.

In many parts of the Barren Grounds there must be as many as 10 linear miles of caribou trails to every square mile of territory. Even if there were only one mile of such trails to each square mile, the total, on the Barrens of Keewatin and Mackenzie alone, would equal or exceed all the railway mileage in the United States.

In contrast to the narrow ridges, the broader hilltops in the Barrens offer such freedom of movement to the Caribou that trails are much less likely to be formed in such places, even when they are frequented by large numbers of the animals. Thus I found the broad summit of Josie's Hill practically without well-defined trails, despite the regularity with which many migrant bands resort thither. In feeding or traveling over such an area, there is no occasion for restricting themselves to a narrow course. In crossing from one ridge to another through an intervening bog, the animals may leave numerous scattered and temporary trails in the dense sedge growth to mark their passage (fig. 13). On the uniform surface of such a bog, as on the broad hilltops, there is no need to confine their steps to any particular course.

It might be supposed that the Barren Ground Caribou would have some reluctance in entering thickly wooded tracts, where Wolves naturally have a much better chance of a close approach than on the open Barrens. As already stated, however, their trails may be found more or less throughout the spruce and tamarack growth in the Windy River area. One of these tracts, covering probably several square miles on the west side of Four-hill Creek, is fairly crisscrossed with trails. At deep dusk on October 2, while several of us were skinning a Black Bear in this thick timber, about

five does and fawns trotted up quite close to us. Perhaps they were on their way to the open Barrens to pass the night. While wintering in the forested Hudsonian Zone, the animals may spend their nights as well as their diurnal resting periods on the frozen lakes and rivers.

Fred Schweder, Jr., says that Caribou are somewhat fearful of sand hills or eskers, and that he has never seen one lying down in such a place; he believes this is because the Wolves frequent the eskers in summertime. On the other hand, Mr. G. W. Malaher spoke of a long esker that extends down the west side of Nueltin Lake and far to the southward; this, he said, forms a migration highway for the Caribou.

References on habitats and trails.—J. B. Tyrrell, 1892: 129, and 1895: 445; W. J. McLean, 1901: 6; Blanchet, 1925: 33, and 1926*a*: 73, 96-97; Mallet, 1926: 79, 80; Seton, 1929, 3: 100-102, 122, 127-128; Jacobi, 1931: 186-187; Ingstad, 1933: 86; Murie, 1939: 246; Manning, 1948: 26-28; Rand, 1948*a*: 212; Harper, 1949: 226, 228; Banfield, 1951*a*: 3.

Influence of weather on distribution

In the section on *Migrations* the meteorological conditions in 1947 have been reported for any possible bearing they may have had on the daily movements of the Caribou, particularly during the fall migration. The temperature has an important effect on the activity of the insect pests (see *Influence of insects on distribution*) and thus, to a certain extent during summer and fall, on the behavior and probably the distribution of the Caribou.

Low winter temperatures on the Barren Grounds do not appear to be a factor of prime importance in the seasonal distribution of *R. a. arcticus.* "Some individuals and small herds remain in the northern part of the range at all seasons" (R. M. Anderson, 1947: 178). Peary's Caribou (*R. pearyi*) inhabits the more northerly Arctic islands throughout the year, without engaging in such extensive migrations as its relative to the south.

The forceful winds that blow over the Barren Grounds so much of the time are of distinct benefit to the Caribou during the summer in abating the very serious scourge of flies. If other things were equal (as they are not), this factor alone would make the Barrens a more favorable summer habitat than the forested country. (See *Retrograde autumnal movement.*) Air movements of similar strength during the winter must, through the wind-chill factor (*cf.* Siple and Passel, 1945), make life so much the harder for any living being; on the other hand, they tend to sweep the ridges bare of

snow, thereby making readily available the Caribou's principal winter food of reindeer lichens (*Cladonia* spp.)

References.—Armstrong, 1857: 479; Critchell-Bullock, 1930: 192, 194-196; Hoare, 1930: 33; Jacobi, 1931: 193, 195; Clarke, 1940: 96, 99; Banfield, 1951a: 27-29.

Influence of food supply on distribution

The strong winter winds on the Barrens affect the Caribou in still another way. While they pack the snow so firmly that man may dispense with snowshoes, this condition naturally increases the difficulty that the Caribou experience in pawing through the snow to reach the lichens that are covered by it. The limited grazing capacity of such areas as are laid bare by the wind may force a reduction in the wintering population. Although the snow in the timbered regions to the south covers virtually the whole surface of the land, it is evidently less compact and so offers more favorable feeding conditions than the areas of hard-packed snow on the Barrens. (Charles Schweder states that Willow Ptarmigan will fly out of the Barrens to spend the night in tracts of timber, where the snow is softer and thus more suitable for the nocturnal burrows of these birds.)

Another apparent inducement for resorting to the tracts of timber in winter is the abundance there of tree lichens, such as *Alectoria* and *Usnea* (*cf.* Richardson, 1829: 243; J. B. Tyrrell, 1894; 441; Dix, 1951: 287), upon which the Caribou may feed without regard to snow conditions. (See also *Retrograde autumnal movement.*)

Reindeer lichens (*Cladonia* spp.) and doubtless other lichens are of such slow growth that forest fires may deprive the Caribou of this indispensable food for a period of years. According to Mr. G. W. Malaher, the recent burning of a large area north of The Pas may have deflected the animals toward the southeast, causing them to extend their migration to an abnormal distance in that direction. For a similar reason in years past, according to Pike (1917 [1892]: 50), they avoided "great stretches of the country" near the Mackenzie River, and also on the south side of Great Slave Lake. A quarter of a century after Pike's time, Dogribs reported that Caribou had not come to the lower Taltson River for several years, "because the timber had been burned off" (Harper, 1932: 30). Some years ago, extensive fires in Manitoba were said to have been deliberately set by prospectors with the aim of exposing the underlying rock.

Charles Schweder believes that the Caribou show a certain predilection for rocky places, owing to the more luxuriant growth of lichens there.

References.—Richardson, "1825": 328-329; Bompas, 1888: 24; Pike, 1917 (1892): 50; Wheeler, 1914: 60; Blanchet, 1930: 52; Jacobi, 1931: 192, 194, 195; Harper, 1932: 30; Ingstad, 1933: 34, 161, 163; Hornby, 1934: 105; R. M. Anderson, 1938: 400; Clarke, 1940: 100, 106-107; G. M. Allen, 1942: 299; Downes, 1943: 261; Porsild, 1943: 389; Wright, 1944: 186; R. M. Anderson, 1948: 15; Banfield, 1951*a*: 5, 11, 27-29.

Influence of insects on distribution

It is quite possible that the blood-sucking mosquitoes (*Aedes*) and black flies (*Simulium*) and the parasitic warble flies (*Oedemagena*) and nostril flies (*Cephenemyia*) have a definite and important influence on the extent and dates of caribou migration.

As far as I am able to judge from my own experience, mosquitoes are more or less equally numerous and ferocious in the Canadian, the Hudsonian, and the Arctic Zones of the Northwest. Naturally the season begins earlier in the more southerly localities. In two seasons (1914, 1920) at the western end of Lake Athabaska they began to be troublesome about the middle of June, whereas at Nueltin Lake this stage was reached about the first of July. In the Athabaska and Great Slave lakes region (Canadian and Hudsonian Zones) I have never had occasion to regard black flies as serious in respect to either numbers or ferocity; but there is universal agreement that conditions are vastly different and worse on the Barren Grounds. At Nueltin Lake the *Simulium* hordes become troublesome at approximately the same time as the mosquitoes. Toward the end of August there is a merciful diminution in the numbers of both mosquitoes and black flies on the Barrens, and after the first of September they may be practically disregarded, except on an occasional day of unseasonable warmth.

It may be remarked in passing that one of the insect terrors of the Athabaska region, the so-called "bulldog" (a species of Tabanidae), did not come to my attention as a pest at Nueltin Lake though I collected two species of *Tabanus*. Malloch (1919), in reporting on the Diptera of the Canadian Arctic Expedition of 1913-18, does not include a single species of Tabanidae. On the other hand, Twinn (1950: 18) states that 17 species have been found at Churchill; he refers to tabanids as "very abundant in forested regions of the North." The "bulldog" may be presumed to contribute to the summer misery of the Woodland Caribou and the Moose as well as of man.

The season during which the adult warble flies and nostril flies harass the Caribou probably lasts only a few weeks in July and August. While the adults evidently cause no pain, they no doubt arouse an instinctive dread in the prospective hosts of their larvae. While I have no information as to whether they follow the hosts into the wooded country, it would appear quite likely that they do so if we are to credit statements by Franklin (1823: 242), Richardson (1829: 251), and B. R. Ross (1861: 438) that these pests infest the Woodland Caribou as well as the Barren Ground species. Furthermore, *Cephenemyia* has been reported in Pennsylvania as a parasite of the White-tailed Deer (*Odocoileus*) (Stewart, 1930?). The scarcity of available study material may be judged from the fact that the Canadian Arctic Expedition of 1913-18 secured only three adults of *Oedemagena* and none of *Cephenemyia* (Malloch, 1919: 55-56).

From the foregoing it may be seen that the wooded country represents a virtually fly-free haven for the Barren Ground Caribou during nearly ten months of the year. Is it any wonder, then, that they hasten throughout August toward or into the shelter of the woods, to gain freedom from the winged scourges of the Barrens? (See also *Retrograde autumnal movement.*)

In the spring migration of 1947 the last of the Caribou passed the Windy River area on July 1, just before the mosquitoes and black flies had become seriously troublesome. It might be surmised that the animals keep marching northward in advance of the appearance of these flies, as long as that is feasible; and that when fairly overwhelmed by the winged hordes, they desist from further progress in that direction. The fawns are born at such a time (in late May or June) as to pass their first few tender weeks before becoming subject to serious insect attacks.

(See also *Retrograde autumnal movement; Relations to flies.*)

References.—Richardson, "1825": 328-329; Hoare, 1930: 33, 37-38; Jacobi, 1931: 193-195; Soper, 1936: 429; Hamilton, 1939: 247, 301; Clarke, 1940: 95-96; Porsild, 1943: 389; Banfield, 1951*a*: 27-29.

Effect of combined environmental factors on distribution

The sum total of environmental factors apparently makes the Barren Grounds a distinctly more favorable summer habitat for the present species than the wooded country, since the latter region is virtually entirely deserted at that season. In general, the wooded country must be a more favorable winter habitat, since the bulk of the animals evidently resort to it at that time; yet its advantages

are by no means clear-cut or overwhelming, since a very considerable proportion of the Caribou elect to spend the winter on the Barrens (Hanbury, 1904: 93, 120, 139; Hoare, 1930: 22, Clarke, 1940: 8-9, 11, fig. 4; Anonymous, 1952: 267).

Relations to man

The Caribou dominates the thoughts, the speech, and the general human activities of the Barren Grounds. As the chief food resource of that region and the adjacent timbered country, it plays a highly important role in the economy of both primitive and civilized man. As long as those regions were occupied only by native Eskimos and Indians, employing such primitive weapons as bows and spears, the species was in no danger. Its vast numbers were maintained steadily from generation to generation, and were perhaps limited only by the grazing or browsing capacity of their range.

With the advent of civilized man and the placing of firearms in the hands of the natives, the situation has deteriorated at a rate that becomes accelerated with the passage of time. If it had not been for the encroachment of civilization and the introduction of its instruments of destruction, the natives would have been assured of a proper meat supply for an indefinite period. Here and there some of them would miss a caribou migration and starve to death; yet the animals have been so generally available that many of the natives even today lack the foresight to put up an adequate supply of fish as an alternative winter food.

Almost everywhere the annual slaughter is both excessive and wasteful. Few inhabitants of the North, whether native or white, stay their hands while Caribou are present and ammunition is available. There is undue reliance on a continuation of past abundance, and an indifference to the welfare or rights of posterity. The whole culture of the inland Eskimos and the northern Indians (the Caribou-eater Chipewyans in particular) is so thoroughly based upon Caribou that the decimation of these animals would mean a fundamental modification or virtual extermination of their culture.

The average trapper of the Barren Grounds apparently aims at killing annually at least 100 Caribou. Only a small portion is required to feed himself and his family. The rest is designed for use as fox bait and dog feed. In September he goes over his trap-line, perhaps 100 miles long, and endeavors to kill Caribou at convenient intervals throughout its length. (In October, 1944, a single trapper killed 90 during two days of a big movement.) The animals are left

where they fall. Presently spells of warm weather may render the meat unsuitable for any one with more fastidious tastes than a hardy man of the Barrens. In any event, the beasts of the field evidently get the lion's share, even when the trapper endeavors to cover the carcasses with rocks or spruces. Bears, Wolves, Foxes, Weasels, Wolverines, Lemmings, Rough-legged Hawks, Ravens, and Canada Jays help themselves to the free feast. Bears in particular are likely to consume the whole carcass; in the autumns of 1944 and 1947 they thus disposed of about 70 and 40 caribou bodies, respectively, within a few miles of the Windy River post. If the season turns out to be a particularly poor one for Arctic Foxes, the trapper may abandon his trap-line for that winter, and dozens or scores of Caribou will have been sacrificed in vain.

Fish, which are available in abundance nearly everywhere, would serve well enough for both fox bait and dog feed. But the average trapper prefers to secure Caribou—a less laborious matter than putting up a winter's supply of fish; at the same time he may admit that fish are easier to handle in feeding and are preferable from that point of view. Charles Schweder has rarely found Caribou along his trap-line between the upper Kazan River and Dubawnt Lake. By using fish (out of the Little Dubawnt River) for fox bait, he avoids the necessity of making an early fall trip over that long distance to secure Caribou for his winter operations. A trapper from northern Manitoba informed me that the local Indians were complying with a recent government regulation that each owner must put up a certain number of fish for the consumption of his dogs—but, they were still feeding them with Caribou. The Split Lake band of Indians on the Nelson River, Manitoba, were reported to have killed 4,000 of the animals during the winter of 1946-47; the greater part of these were utilized ingloriously as dog feed.

The hunting of such an extraordinarily unwary animal as the Barren Ground Caribou calls for extremely little skill. Scarcely anything more is required of the hunter (at least in southwestern Keewatin) than to place himself on their line of march and to await their arrival. No concealment is necessary, but quick movements are to be avoided, and the direction of the wind should be such that it will not carry the dread human scent to the animals. Even in perfectly open terrain one may generally walk slowly up to within shooting distance of resting Caribou. But if they are on the march and have already gone past, the hunter may not succeed in getting

close to them. Pursuing them on the run is likely to send them off in a panic. (There is some evidence that on the Arctic Coast and in the Barren Grounds of Mackenzie, where hunters are probably more numerous than in southwestern Keewatin, the Caribou are usually much more wary—*cf.* Amundsen, 1908, **1**: 103; Stefánsson, 1913*b*: 278; Blanchet, 1925: 34; Ingstad, 1933: 88.) In the section on *Disposition* the destruction of about a quarter of a herd of 100 or more by a single hunter is described. On September 9 an Eskimo boy killed 13. On November 3 eight out of a herd of 50 were secured by another hunter in a few minutes' time. During the autumn migration of 1947 one of the Eskimos on the upper Kazan had killed 85 before the end of September. This band of Eskimos is said to have once slaughtered 500 animals, half of them in the river, where they did not even bother to pull them out; they had killed for the sheer delight of killing rather than for utilization. It is customary for them to spear more animals than they shoot. A trader's family in the Nueltin Lake region used to kill 500 Caribou per year for their own use and for their 23 dogs. In one instance a number of Caribou were shot from across a river; several hours elapsed before a canoe became available, and by that time the bodies were frozen so stiff that no attempt was made to use them. It was reported that tractor crews operating between Reindeer Lake and Flin Flon brought out many hind quarters to sell illegally at the latter point, leaving other parts of the bodies along the way. In the winter of 1944-45 Nueltin Lake was said to have been covered with the bodies of Caribou that the Chipewyans had shot for "fun" and had neglected to utilize. It was also reported that in May, 1947, there were many neglected bodies in the vicinity of Duck Lake, the local Chipewyans having killed the animals during the previous fall; meanwhile the spring migration had commenced and was furnishing all the fresh meat required.

In the Windy River area nearly all the Caribou were secured with rifles. A few, however, were speared by the Eskimo boy as they swam across Windy Bay. The spears used here are manufactured articles of iron, fitted to a wooden shaft.

Katello, a Kazan River Eskimo, informed Charles Schweder that his people used to construct snow-covered pits for the Caribou to fall into. The present generation is considered too lazy to undertake such a task. Although information is lacking in the present case, urine may have been employed to entice the Caribou into these pits, as reported by Hanbury (1904: 114-115, 123, fig.).

A general deterioration of antler size in the Barren Ground Caribou seems to constitute a case parallel with that of the European Red Deer (*Cervus elaphus elaphus*). The reason is evidently the same in each case—the long-continued selection by hunters of old males with the best "heads." Only the motive differs decidedly in each case: the European hunter looks upon the antlers themselves as the main prize; the Eskimo and the Indian are indifferent to these ornaments, but realize that the bucks with great antlers provide the most meat and *fat*. The bucks are said to become much fatter than the does. The Eskimos are especially keen on getting the big bucks. According to Charles Schweder, the old antlers left at the river crossings from bygone days are superior in size to those of the present day. He himself has never secured a set of antlers equal to one (fig. 25) lying on the shore of Simons' Lake; it may have been there for 20 or 30 years prior to 1947.

From about mid-September to nearly mid-October the flesh is counted upon as being in especially fine condition. In August, 1947, the animals had scarcely any fat, but by the middle of September the roasts were delicious. On October 8 the fresh strips of back fat from several bucks weighed about 5 to 10 lbs. each. A good many of these strips were put in a storehouse at Windy River for winter use. Charles Schweder remarked on having seen such a piece of fat 3 inches thick. At the rutting season, which commences about mid-October, the bucks become very poor and thin. They neglect their feeding and do not have full stomachs, as earlier in the season. Their fat becomes tinted with red, and the flesh becomes so musky that even the dogs and the Wolves disdain it. (See also the section on *Fat.*)

In some cases, when a local Caribou is being dressed, a part of the stomach is utilized as a receptacle into which the blood is dipped from the body cavity with the hands, in Eskimo style. The blood goes into the making of soup. The tripe also is relished. Once I found the children of our camp boiling up a section of the aorta as a delicacy. The ribs are commonly impaled on a stick thrust into the ground and roasted in front of an open fire. Leg bones may be cracked to render the raw marrow accessible; if they are cooked, the marrow may be blown out of the open ends with the mouth. The Padleimiut consume much of the meat in the raw state, and frequently wash it down with hot tea.

Much needless wounding and suffering of the Caribou, as well as waste of valuable resources, result from extensive use of such a

small-calibred rifle as the .22. It may seem remarkable that such a large animal should succumb at all to such a slight weapon; but it does happen, usually after a number of shots. For example, an Eskimo boy secured 13 Caribou in a single day with a .22. On the other hand, many of the animals must get away from the hunter, only to die, after much suffering, at a considerable distance, where they are not likely to be recovered and utilized. The absolute outlawing of the use of the .22 on such large game would seem to be in order.

Once Charles Schweder shot a doe whose jaw had been broken by a bullet. A piece of the bone had "grown into the tongue" but the jaw was healed.

At the Windy River post, in the latter part of summer, portions of the caribou bodies are placed in the river not merely for refrigeration, but for protection from blowflies. Such meat is used mainly for the dogs. The Eskimos are said not to engage in this practice. Consequently, some of the caribou bodies lying about their camps become masses of maggots.

On the last day of September I observed how Charles Schweder prepared a fresh caribou body in the field and endeavored to protect it from beasts and birds. First he cut off the head with his hunting-knife; then the hind legs, which were severed very readily at the hip joint. Next he opened the body cavity and pulled out the viscera, setting aside a mass of fat (apparently the omentum). The hind legs were placed beneath the body, and the head was thrust into the opening of the abdominal cavity, as an obstacle to such scavengers as Herring Gulls, Rough-legged Hawks, Canada Jays, Ravens, and Foxes (*cf.* Downes, 1943: 227, 228). The skin was left on the body, and the whole was covered with small spruce tops.

An interesting device in the hunting of Caribou consists of "stone men" (Harper, 1949: 231, fig.) They are made of rocks, piled one upon another in such a manner as to faintly suggest a human figure. "Moss" (either moss or lichens) is added to some of them to enhance the human appearance. A considerable number may be seen in the Windy River area, where they are generally placed along the summits of the ridges. Construction was probably begun many years ago by natives, and has been continued by the present residents. When Caribou, in fleeing from a hunter, catch sight of these "stone men," they are likely to pause in suspicion of the figures, and to be deflected from their chosen course. This may give the hunter a chance to come within range of the animals. The Kaz-

an River Eskimos are said to use converging lines of such rock piles to direct migrating Caribou to certain river-crossings, where the hunters lie in wait for them. Occasionally a single pile is erected merely to mark the spot where a caribou body is left until the hunter can return with a dogteam to fetch the meat.

On first securing one of the animals, the hunter makes a practice of cutting out the tongue and carrying it to camp in a pocket or a game-bag. On a subsequent trip, if there is sufficient snow on the ground, the meat is generally transported by dog sleigh or toboggan (*cf.* Harper, 1949: 231, fig.). Occasionally a hunter will carry it on his shoulder (fig. 4) or in a pack.

In all the Canadian North, as far as I am aware, the Windy River post is virtually the only place where summer transportation is accomplished by dog-drawn travois (fig. 5). This device, consisting of two trailing poles, with a small platform midway, is recognizable immediately by readers of Parkman's *Oregon Trail* (1849), where its use by Indians of our Western Plains is mentioned again and again. The travois was introduced into this region by the late Charles Planchek?, a Czech? trapper of somewhat sinister repute, whose headquarters were at Putahow Lake. He was the "Eskimo Charlie" of Downes (1943: 160-161, pl.). In years gone by he took a travois with him on a visit to the Windy River area, and it was thereupon copied and subsequently used regularly by the Schweder family. Their Eskimo friends of the upper Kazan will occasionally borrow one, but I am not aware that they have made any travois of their own. During the summer the two younger boys of the Windy River post made a practice of hauling in caribou meat from the surrounding Barrens by means of travois.

In the latter part of summer some small pieces of caribou meat were occasionally laid on a stone for drying, in front of the door at the post. Other pieces were said to have been hung up in the air for the same purpose, without fire or smoke, out in the field where the animals were killed. Apparently blowflies did not pay much attention to this meat. No considerable quantity seemed to be preserved locally in this way. Three Caribou-eater Chipewyans from the south end of Nueltin Lake, who visited our camp in late October, were carrying dried meat with them as travel rations and eating it without cooking.

The larvae of the warble fly (*Oedemagena tarandi*), found beneath the skin of the Caribou, are relished by the Eskimos, being eaten apparently while alive and raw. The Eskimo boy of our

FIG. 9. A band of Caribou swimming across Little River at its mouth and landing on the western shore. Toward the left, a doe standing broadside and enveloped in a cloud of spray being shaken off. August 28, 1947. (From a 16-mm. motion picture.)

FIG. 10. Two Caribou bucks standing in the edge of Little River at its mouth after swimming across. August 28, 1947. (From a 16-mm. motion picture.)

FIG. 11. A one-horned doe, a hornless doe, a fawn, and a two-horned doe among a band of Caribou approaching the camera within a rod after swimming across Little River. August 28, 1947. (From a 16-mm. motion picture.)

FIG. 12. A band of Caribou (chiefly big bucks) swimming across Little River at its mouth. August 28, 1947.

FIG. 13. Camp Slough, with trails showing the recent passage of Caribou through the sedge growth (predominantly *Carex chordorrhiza*). Black spruce in the foreground and distance. August 29, 1947.

FIG. 14. A Caribou *Elysium*: a hornless doe approaching within 15 feet of the photographer at the mouth of Little River. August 30, 1947.

FIG. 15. Anoteelik in caribou-skin clothing, holding a caribou spear. A buck on the skyline. Mouth of Windy River, September 7, 1947.

FIG. 16. Katello, a Padleimiut Eskimo from the upper Kazan River, in a coat (*attigi*) and boots (*komik*) of caribou skin. Windy River, Oct. 6, 1947.

FIG. 17. Charles Schweder with the fresh, warble-infested hide of a Caribou buck (specimen No. 1033). Windy River, June 3, 1947.

FIG. 18. Hide of a Caribou doe, about four years old, with about 130 small warbles or warble scars (concentrated on the rump). Windy River, September 15, 1947.

camp continued this practice after his little sister had given it up. Hearne (1795: 197) reported the Indians as eating the warbles in his day.

Only a small proportion of the hides of the locally killed Caribou are preserved. A hide that would fetch only a dollar at Reindeer Lake would not be worth transporting more than 250 miles from Nueltin Lake. Hearne long ago (1795: 84) remarked on the remoteness of the hunting grounds from the trading posts as a barrier to trade in the skins; and this condition prevails to a large extent to the present day. Thus only such hides as are required for domestic use are kept. Tanning, while done by the Eskimos of the upper Kazan, is not undertaken by the residents on Windy River. Here the task of drying the hides is left mainly to the children of the camp. Most of them are pegged out on the summit of a gravelly ridge, wooden pegs being driven with a rock through slits in the edges of the skin (fig. 6). Now and then one is nailed to the outer wall of a log cabin (fig. 18).

One of the main uses of the hides is for winter clothing. The Windy River residents have their garments made by Eskimo women of the upper Kazan, whose tanning process leaves the fur intact. Early autumn hides, with new, comparatively short fur, are the ones in demand. The season for securing such hides is said to extend to mid-September. At that season the larvae of the warble fly have not developed far enough to have injured the hide appreciably. The long winter fur is much less suitable for clothing. In moderately cold weather a single coat (*attigi*), with the fur inside (fig. 16), is worn by the Eskimos. This coat, when made for a man, extends very little farther downward at the rear than at the front; but a woman's coat is considerably longer at the rear. The bottom is generally provided with a fringe consisting of small strips of caribou skin, perhaps 4 inches long and 1/16 inch wide. In mid-winter another coat, with the fur outside (fig. 15), is slipped on over the other. Both are provided with hoods. Trousers, with the fur outside, are cut rather short at the bottom; some such material as rope is passed around the waist, without belt loops, to hold the trousers up. Boots (*komik*) of tanned caribou skin (fig. 16), reaching nearly to the knees, with the fur inside, make exceptionally warm footgear in winter. An extra piece is sewed on the sole, with the fur outside, but the hairs soon wear off. The seams are sewed with sinew. Another sort of boot, for summer use, is made of untanned skin, without the fur, and is more or less waterproof. Mittens

(*pahloot*) have the fur outside; the thumb piece, of a length suitable for a short Eskimo thumb, does not properly fit a white man.

In the autumn of 1947 the migrating Caribou did not reach the territory of the Chipewyans about the south end of Nueltin Lake till about November 1—by which time the fur had grown so long that it was not suitable for clothing. When I inquired of Charles Schweder how these natives managed under such circumstances, he replied that nowadays they use very little skin clothing—just manufactured clothing. Certainly the latter type was being worn by three men of this tribe that visited the Windy River post in late October. In this connection it is interesting to note that in November Charles brought to Windy River a bundle of fawn skins that he had secured from an Eskimo on the upper Kazan. Presently he traded them to a Cree halfbreed from the Putahow River, who was to have them made into a coat for himself. In years gone by the above-mentioned Chipewyans must have found some means of securing caribou skins for themselves in August or September; they could have accomplished this by moving to the northern part of Nueltin Lake, provided the animals had not reached the southern part at the proper season.

From Charles Schweder I learned that the Hudson's Bay Company acquires caribou skins (apparently tanned) from the Duck Lake Chipewyans at about a dollar apiece, puts them up in bales of perhaps 10 to 20 skins, and ships them by steamer from Churchill to Baffin Island or thereabouts, for use by the Eskimos. He had seen about 25 or 30 such bales being loaded on a steamer in September, 1947. This trade evidently results from the present scarcity of Caribou on Baffin Island (*cf.* Manning, 1943*a*: 47-50; Soper, 1944: 247-250; Banfield, 1949: 481). Moccasins of caribou skin, made by the Duck Lake Chipewyans, were on sale at Churchill.

The three Caribou-eater Chipewyans from the south end of Nueltin Lake brought mittens, gloves, and moccasins of caribou skin to trade at Windy River. Similar gloves were brought by a Cree halfbreed from the Putahow River.

At the Windy River post furred caribou skins served in upholstering the seat, back, and arms of a couple of home-made chairs. They were used also as mattresses or blankets, in the making of sleeping bags, and even as insulating material on the outside of the cabin (Harper, 1949: 226, 228, figs.). The Schweder boys also maintain tents of caribou skin at various points on their long traplines; they are much warmer than canvas tents, and require no out-

lay of cash. The skins are nailed on poles arranged in tepee form; the height of such a tent is about 10 feet, and the diameter 9 or 10 feet. There is a home-made stove inside, with the smoke-pipe projecting outside about halfway to the top of the tent.

The Eskimos of the Kazan River have large summer tents of caribou skin, and smaller ones of canvas. The former are the ones in which the drum dances are held. These Eskimos never make their winter houses wholly of snow, according to Charles Schweder, but use caribou skins for the roof.

In illustration of the primary importance of the Caribou to both primitive and civilized man in the Arctic and the sub-Arctic, the numerous cases of partial or complete starvation in the absence of Caribou may be cited. The chronicles of northern explorers are replete with them. A notable case is that of John Hornby and his two companions on the Thelon River in the winter of 1926-27 (Hoare, 1930: 25; Christian, 1937). In the autumn of 1946 only a small fraction of the normal caribou migration passed by the Eskimo camps on the upper Kazan River. These happy-go-lucky, utterly improvident people did not take steps to secure an alternative winter's supply of fish, and by the following spring eight out of the band of 27 persons had succumbed directly or indirectly to starvation. (It is suspected that several were accounted for by anthropophagy.) Women, children, and dogs were the victims; no adult male succumbed. The casualties would doubtless have been more numerous if Charles Schweder had not reported the plight of the band when he made a trip to Reindeer Lake in March. Thereupon the government shipped emergency rations by plane as far as Nueltin Lake, and Charles transported them from that point by sleigh to the Kazan. Meanwhile he rescued two of the orphan children, took them to the Windy River post, and in a few more months formally adopted them.

Ethnological material from caribou products

In addition to the utilization of caribou products for the primary purposes of food, clothing, and shelter, as discussed in preceding pages, certain other uses of an ethnological nature may be mentioned here.

Charles Schweder spoke of the former Eskimo use of splint bones from the legs of Caribou as needles, after a hole had been drilled or burned through the larger end. They are about the same length as a large darning needle. These people commonly

use the back sinew as thread or as wrapping on tools, drums, and the like. I saw a piece of back sinew being dried for future use at the Windy River post.

Either lard or caribou fat serves as fuel for an "Eskimo candle"; the wick is a bit of rag or moss. The heat of the flame melts the fat where it is spread out in some small receptacle like a can cover. When our other means of illumination gave out at the Windy River post, I worked or wrote notes for many hours by the light of one of these candles. It gives approximately as much illumination as an ordinary tallow candle. One disadvantage of using caribou fat for this purpose is the considerable amount of smoke that it produces.

The Eskimos make odd use of an antler as a brake for a sleigh, to prevent the harnessed dogs from running after any Caribou they may sight; on other occasions it retards the sleigh in descending a hill. Such an antler, that I found at the Windy River post, is notched near the base; a rope or thong, 2 or 3 feet in length, is fastened at one end to this notch, and at the other to the side of the sleigh. To apply the brake, the driver simply presses down the points of the antler into the snow or ice.

The drums used in the ceremonial dances of the Kazan River Eskimos are made of a piece of caribou skin stretched tightly over a circular frame of spruce and fastened in place with caribou sinew. They are about 3 feet in diameter.

In an Eskimo fish spear from the upper Kazan River an iron barb on one of the prongs is supported by a small piece of caribou antler and fastened with back sinew. The two large lateral prongs, of metal, are tied to the wooden shaft of the spear with braided sinew.

Two snow-knives have handles of antler, about 10 and 11 inches in length. One of the handles has been planed down, and is wrapped with sinew.

The handle of another implement, used in cleaning out grains of wood from a hole being drilled in wood, is also a piece of antler.

A woman's knife, or *ooloo,* has a section of antler for a handle.

Strands of beads, used either for an ear pendant or for ornaments at the peak of a hood, have a caribou incisor fastened at the tip. The opposite end of the pendant is provided with a thin strip of caribou hide for fastening to a perforated ear lobe.

The willow stems of pipes are wrapped with back sinew.

Antler and sinew went into the making (by Anoteelik) of a "ring and pin" game.

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References on relations to civilized man.— Kennicott, in Anonymous, 1869; 166; Schwatka, 1885: 59-86; A. J. Stone, 1900: 57; Grant, 1903: 186; Cameron, 1912: 309; R. M. Anderson, 1913*a*: 5, 6, 1913*b*: 504, and 1938: 400; Stefánsson, 1913*b*: 27; Hornaday, 1914, **2**: 100; Wheeler, 1914: 56; Hewitt, 1921: 11-12, 59; Critchell-Bullock, 1931: 33; Godsell, 1937: 288; G. M. Allen,

1942: 298-299; Manning, 1942: 28; [U.S.] War Department, 1944: 77; Harper, 1949: 239; Banfield, 1951*a*: 1, 14-15.

Relations to Black Bears

It is hardly to be expected that Black Bears (*Ursus americanus* subsp.) commit any depredations on adult, able-bodied Caribou unless under very exceptional circumstances. Since they do not normally venture to an appreciable distance into the Barren Grounds, their contacts with Caribou are mainly in the forested zone. For an untold period in the past there has been a very interesting tripartite relationship between Bears, Caribou, and Caribou-eater Chipewyans about the south end of Nueltin Lake. For information concerning it I am indebted to Charles Schweder. The Indians of that area have been in the habit of killing large numbers of Caribou, especially on the spring and fall migrations, and leaving many of the bodies, or parts of the bodies, out in the "bush." The Bears have become accustomed to taking advantage of the situation, especially, perhaps, in the matter of fattening up for hibernation. This probably resulted in a certain concentration of the animals thereabouts. But of late years the local native population has seriously declined by reason of fatal illness and removal to other parts. Consequently, as Charles Schweder expressed it, there are no longer enough people there to feed the Bears! Three of the Chipewyans reported in late October, 1947, that they had lost a good many of their Caribou to the Bears during that season.

This recent change in the food situation about the south end of Nueltin Lake has apparently resulted in, or at least coincided with, an influx of Bears in the Windy River area, where they were unknown until 1944. During the next four years seven Bears were killed locally. The animals are said to have consumed about 70 Caribou bodies in the fall of 1944, and about 40 in the fall of 1947 within a few miles of the Windy River post; thus they became a somewhat serious factor in the human economy of the area. The Caribou is evidently the chief loser in this curious relationship, but even the Bear, which may be regarded as the chief beneficiary, suffers from man's retaliatory efforts.

Relations to foxes

The demand for Arctic Fox furs on the part of the fashionable women of the world sends the trapper on his winter rounds over the bleak and bitter Barren Grounds, where he depends upon his autumn kill of Caribou for sustenance for himself and his dogs as

well as for fox bait. It is thus quite obvious where a large share of the responsibility for the dwindling numbers of the Caribou lies.

Both Arctic and Red Foxes (*Alopex lagopus innuitus* and *Vulpes fulva* subsp.) are among the scavengers that help to consume caribou bodies that are left unguarded in the wilds. According to Charles Schweder, foxes of both species seem to follow the Wolves, presumably in the hope of securing the leavings of their kills.

Charles also gave me an account of a remarkable sort of play between a Red Fox and a small buck Caribou. He had witnessed it in September, 1943, about 18 miles north of Windy River, from a distance of half a mile. The Fox would approach the Caribou closely; the latter would then walk up to the Fox, which would retreat, not allowing the Caribou to come close enough to touch it. Neither animal was afraid of the other. They kept up this performance for about 5 minutes. The Fox then went among some bushes, where the Caribou tried to follow it. The larger animal was still there, feeding, when Charles passed on out of sight. He regarded the whole performance as a matter of playfulness. His recital put me in mind at once of a slightly similar play between a Newfoundland Caribou and a Red Fox, as recorded by Millais (1907: 302-303). Stefánsson (1921: 623-624) describes a game of tag between an Arctic Fox and several yearlings of *Rangifer pearyi* on Melville Island.

References.—Blanchet, 1925: 34; Birket-Smith, 1929(1): 101; Critchell-Bullock, 1930: 143; Munn, 1932: 278; Ingstad, 1933: 90, 157-159; Freuchen, 1935: 128; Banfield, 1951*a*: 36.

Relations to Wolves

Aside from man, the principal predatory enemy of the Barren Ground Caribou is undoubtedly the Wolf. A comparison of a distributional map of Caribou by Banfield (1949: 479, fig. 1) with a distributional map of Wolves by Goldman (1944: 414, fig. 14) indicates that the latter species is a considerably more plastic animal. No less than six subspecies of Wolves seem to occur in parts of the currently recognized range of a single subspecies of Caribou (*Rangifer arcticus arcticus*), as follows: *Canis lupus arctos,* Prince of Wales and Somerset islands; *Canis lupus manningi,* Baffin Island; *Canis lupus bernardi,* Victoria Island; *Canis lupus hudsonicus,* Keewatin, eastern Mackenzie, northern Manitoba, and northeastern Saskatchewan; *Canis lupus mackenzii,* northern Mackenzie; *Canis lupus occidentalis,* southern Mackenzie and northern Alberta and Saskatchewan.

The Keewatin Tundra Wolf (*C. l. hudsonicus*) is presumably the only one that concerns us here. However, its extension into the forested zone of northern Manitoba and northeastern Saskatchewan, as indicated on Goldman's map, is still problematical. Goldman's text (1944: 428-429) is quite indefinite on this point. There are such distinct differences between the general fauna of the Arctic Zone and that of the Hudsonian Zone that the Wolf of the latter zone may well prove to be differentiable from *hudsonicus,* whose type locality is at Schultz Lake in west central Keewatin. It is an interesting question whether any Wolves of the Barren Grounds follow the Caribou southward into the timbered country in the fall; likewise, whether any individual Wolves of the latter region accompany the Caribou on their spring migration out into the Barrens. Little light on the subject seems available at present. There is no doubt, however, that a good many Wolves remain during the winter on parts of the Barren Grounds that have been deserted by the Caribou at that season. Furthermore, at the time of the spring migration, mature Wolves of the forest zone would be restricted to their home territory by the necessity of caring for their young ones.

A Wolf is by no means able to capture a Caribou at will. During the season of open water the latter may effect a ready escape by plunging into the nearest river or lake and crossing to the other side. There is reason to believe that islands provide a good sanctuary during the summer (Seton, 1929, **3**: 108-109; Gavin, 1945: 228). In the winter the Caribou must depend primarily on its fleetness of foot. Even the fawns are reputed to be able to outdistance Wolves in a chase that is not too prolonged. An adult, if brought to bay after a long chase, is probably able to stand off a single Wolf indefinitely. Its powerful hoofs are its principal means of defense. Even if the antlers are brought into play, they are effective only during the limited period when they are fullgrown, hard, and free of velvet. When two or more Wolves manage to bring a Caribou to bay, the outcome is probably almost invariably in their favor. Charles Schweder has never known a Caribou to kill one of these predators in defending itself. In several cases reported by Fred Schweder, Jr., the last stand was made on the ice of lakes. The Caribou itself may choose such a place, as if aware that it may be more sure-footed on the ice than its enemy.

After listening to wolf tales by residents of the frontier settlements rather than by real men of the "bush," one might almost expect to see a couple of these bloodthirsty animals harrying the rear

of every band of Caribou and keeping up a relentless pursuit. However, during a sojourn of six months on one of the best Caribou ranges in Keewatin, where trapping has very little effect on Wolves, I saw just one of these animals alive, heard the howling on several occasions, and noted a single Caribou that had probably been killed by them. It is far from a common experience for the resident trappers to witness actual pursuit by Wolves or even to find their kills. The following instances, related by Fred Schweder, Jr., comprised his only direct observations on Wolves in pursuit of Caribou up to and including 1947, when he was eighteen years old.

During the northward migration in May, 1945, a silent black Wolf pursued a band of 100 Caribou over the ice of Windy Bay. At one time it came within 100 feet, but thereafter they forged ahead. After half a mile the band split up, and the Wolf desisted. In October, 1946, Fred noticed a Caribou fighting off two Wolves on the ice of Nueltin Lake near its outlet. It used both horns and hoofs against its attackers. While one Wolf was in front, the other would try to get in the rear of the Caribou and hamstring it. This went on for two hours until darkness hid the scene. The next morning the Caribou was dead and half eaten. On October 16, 1947, a white Wolf was seen in pursuit of four fast-moving Caribou near Simons' Lake. It was about half a mile in their rear, and presently halted, probably by reason of catching sight of Fred.

November 7, 1947, was a blizzardy day; the air was full of drifting snow. Under these conditions a gray Wolf chased a buck and a doe right into the dooryard of one of Fred's trapping camps 10 miles north of Windy River. It was only about 30 feet behind them. When the buck broke through the ice of a little creek, the Wolf went right past it in pursuit of the doe. The latter nearly ran into Fred's toboggan, and he shot it at a distance of 20 feet. The Wolf came within 40 feet, but by the time it was recognized as not just another Caribou, it was 100 feet away. Fred then shot but merely wounded it, the sight being off his rifle. Meanwhile the buck escaped, but 3 miles away Fred met with it again and secured it. He recognized it as the same animal because at both encounters it was limping from a previous wound and was hornless as well.

In late November Fred found two fullgrown bucks and a doe on the ice of Windy Lake, where they had been killed by Wolves. The bucks were antlered and had probably met their end several weeks previously. Yet their flesh was so musky and unpalatable, in consequence of the rutting season, that it had not been devoured.

A long trail of blood and hair led to the spot where the doe had fallen, apparently a couple of weeks previously; it was still only half eaten.

In Fred's opinion, Caribou are apprehensive of sandy eskers as the haunt of Wolves, and do not linger there.

On October 15 Charles Schweder pointed out the body of a Caribou in a little pond in the delta area at the head of Simons' Lake. He considered it killed by Wolves some weeks previously; its antlers were in the velvet, and it had been eaten only about the head and hind quarters as it lay in the water.

Joe Chambers, a trapper of Goose Creek (south of Churchill), stated that Wolves select the fattest Caribou, and that during the winter of 1946-47 they had been devouring only such choice parts as the tongue and the unborn young.

Caribou bodies are the primary bait for Wolves and Foxes on the Barren Grounds. Two traps are commonly placed at each carcass.

Up to a couple of centuries ago, when the baneful effect of civilized man began to be felt, the Caribou throve and multiplied to a point where they probably strained the grazing capacity of the Barren Grounds. Neither primitive man nor the Wolf had any serious effect on the size or condition of the herds. The Caribou were numbered by millions, and they doubtless owed their vigor and their success as a species in no small measure to their friendly enemy, the Wolf. Through long ages the latter had tended to eliminate the weaklings, the sickly, and the less alert individuals, leaving the fitter animals to propagate their kind. Here was a fine example of natural selection operating to the advantage of the Caribou. Thus the Wolf may be safely considered a benefactor of the species as a whole—a regulator and protector of its vitality.

There are only two regions of the world where Caribou (or Reindeer) have not long shared their territory with the Wolf—Spitsbergen and the Queen Charlotte Islands. And what sort of situation do we find there? Instead of thriving in the absence of such a natural predator, the animals of both regions are the runts of the whole Caribou-Reindeer tribe, and those of the Queen Charlottes have become virtually or wholly extinct (*cf.* Banfield, 1949: 481-482). Furthermore, the Newfoundland Caribou suffered a very serious decline after the Newfoundland Wolf became extinct at about the beginning of the present century. The lesson is obvious:

it is folly for man to imagine that he can benefit the Caribou by eliminating the Wolves.

It is virtually axiomatic that no predatory species (other than modern man) exterminates its own food supply. Long ago nature must have established a fairly definite ratio between the populations of the Wolf and the Caribou. Although a certain fluctuation of that ratio could be expected from time to time, each fluctuation would be followed by a return to more or less normal conditions. The trend of evolution has doubtless been toward perfecting the Wolf in its ability to capture the Caribou, but at the same time toward perfecting the Caribou in its ability to escape the Wolf. Unequal progress of this sort on the part of the two species would presumably have been rather disastrous to the one or the other. But it is nature's way to have preserved a proper balance between the abilities of the two species, and thus between their populations. This balance (a rather delicate one) has probably been upset to some extent by the advent of civilized man with his devices to the Barren Grounds.

The Caribou "exemplify the survival of the fittest; none but the perfect are allowed to live and breed, hence their perfection. We believe that the wolf is in no small degree responsible for this high standard, and that were he killed off the species as a whole would suffer." (Critchell-Bullock, 1930: 161.)

"It is doubtful if the efforts of white or native hunters are of any importance whatever in the control of wolves in the caribou country, or could, under present circumstances ever be of any importance." (Clarke, 1940: 109).

References.—Franklin, 1823: 242, 327, 344, 486, 487; John Ross, 1835*a*: 402, 530, 534, 564; Back, 1836: 128-129; Simpson, 1843: 232; Armstrong, 1857: 395, 480-481, 488, 525; Osborn, 1865: 227-228, 231, 232; Kumlien, 1879: 53, 54; Gilder, 1881: 61; Bompas, 1888: 60; Collinson, 1889: 244; Pike, 1917 (1892): 56-58; Whitney, 1896: 239; Jones, 1899: 374-375; Preble, 1902: 41, and 1908: 214; Hanbury, 1904: 89; MacFarlane, 1905: 692-693; Amundsen, 1908, **1**: 102; Seton, 1911: 225-226; R. M. Anderson, 1913*b*: 516: Stefánsson, 1913*a*: 93, and 1921: 248-249, 475-476; Blanchet, 1925: 34; Mallet, 1926: 79; Birket-Smith, 1929 (1): 51; Seton, 1929, **1**: 344-346, and **3**: 108-109; Blanchet, 1930: 54-55; Critchell-Bullock, 1930: 159-162; Hoare, 1930: 22; Kitto, 1930: 89; Jacobi, 1931: 240-241; Harper, 1932: 31; Sutton and Hamilton, 1932: 33, 35, 36, 81, 82, 84, 85; Ingstad, 1933: 157-159, 165-166, 207, 302-304, 306-307; Hornby, 1934: 106, 108; Freuchen, 1935: 93, 120-122; Murie, 1939: 245; Clarke, 1940: 107-109; Manning, 1942: 29, and 1943*a*: 55; Downes, 1943: 262; Young, 1944: 236-238, 243; Yule, 1948: 288; Harper, 1949: 230-231, 239; Banfield, 1951*a*: 37-41; Anonymous, 1952: 263-265.

Relations to birds of prey

These relations are not so much of the living Caribou as of their bodies after death. The principal avian scavengers in the

Windy River area seem to be the Rough-legged Hawk (*Buteo lagopus sancti-johannis*), the Herring Gull (*Larus argentatus smithsonianus*), the Canada Jay (*Perisoreus canadensis canadensis*), and the Raven (*Corvus corax principalis*). These birds are evidently attracted to the vicinity of camps and trap-lines by reason of the numbers of caribou bodies lying about. On their first arrival in late May or early June, before the lakes have opened up and while food in general is scarce, Herring Gulls seem particularly prone to assemble where Caribou have been recently killed. For example, up to June 3 only a handful of these birds had been seen about Windy River. On that day several Caribou were killed, and on June 4 about 100 Herring Gulls had gathered at the scene. Their scavenger activities make it especially necessary to protect the caribou bodies in the way described in the section on *Relations to man.* In a few days one of the bodies (apparently not so protected) had been almost entirely consumed. The Herring Gulls operate locally only from May to September, being absent during the rest of the year. A few Ring-billed Gulls (*Larus delawarensis*) appeared meanwhile and attacked a caribou carcass.

The Rough-legged Hawk is far less numerous than the Herring Gull and so is a much less serious scavenger. Now and then, however, it may be noted feeding on a caribou carcass. Even the Long-tailed Jaeger (*Stercorarius longicaudus*) is reported in such a role. The Canada Jay and the Raven are permanent residents and are undoubtedly helped through the inhospitable winter by man-killed Caribou. On the other hand, a good many Ravens fall victims to the fox traps placed about the bodies. Charles Schweder has frequently seen Ravens following Wolves, as if in expectation of a kill. Buchanan remarks (1920: 248) concerning the Reindeer Lake region, that the Ravens "appear to remain in the vicinity of the Caribou herds all th[r]ough winter." In the Windy River area the Canada Jay became noticeably more numerous in August, after the Caribou had returned from the north. The Ravens and the Rough-legs exhibited a similar increase in September and October.

The depredations of these carnivorous birds result to the detriment of the living Caribou in that they virtually force the hunters and trappers to kill a larger number of the animals than would otherwise be necessary.

References.—Hanbury, 1904: 135; Stefánsson, 1913*a*: 93; Seton, 1929, **3**: 108; Ingstad, 1933: 157-159; Downes, 1943: 228; Banfield, 1951*a*: 36, 42; Harper, 1953: 28, 60, 62-64, 72, 74, 76.

Relations to miscellaneous animals

The Schweder boys spoke of Arctic Hares (*Lepus arcticus andersoni*) being in the habit of eating the stomach contents of Caribou after the animals have been dressed in the field. This represents merely harmless utilization of a normally waste product, although it serves some of the natives as *nerrooks* or "Eskimo salad" (*cf.* Richardson, 1829: 245). Wolverines, Mink, Weasels, and Lemmings help to consume unprotected caribou bodies. (In the Old World the Wolverine is regarded as a serious enemy of live Reindeer [Jacobi, 1931: 243; Harper, 1945: 473].)

References.—Pike, 1917 (1892): 56-58; Seton, 1911: 252, 1929, **2**: 413, 424, 443, and 1929, **3**: 108; Harper, 1932: 23; Ingstad, 1933: 157-159; Freuchen, 1935: 93, 99; Hoffman, 1949: 12; Banfield, 1951*a*: 36, 41; Harper, 1953: 40, 41.

Relations to flies

Flies of various kinds perhaps cause more wide-spread, year-round misery to the Caribou than all other pests and enemies combined. It is safe to say that not a single individual in the whole population escapes their attacks, and some even succumb to mosquitoes (Gavin, 1945: 228). The various biting and parasitic flies have already been discussed to some extent in the section on *Influence of insects on distribution.* Harassment by these pests is believed to be the leading cause of the haste with which the Caribou are frequently seen passing over the Barrens in summer. Downes (1943: 204) has commented on the habit of Chipewyan hunters in the Nueltin Lake region of examining the legs of Caribou for swellings caused by mosquito bites. In a buck secured on August 17 the legs exhibited numerous little bumps of this sort; furthermore, black flies covered the buck's body, while scarcely troubling those of us who were preparing the specimen. Fortunately the suffering from mosquitoes and black flies on the Barrens is largely limited to the months of July and August.

Even at this season the Caribou are granted occasional relief from the blood-sucking flies. The characteristic strong winds of that region help greatly in keeping the insects in abeyance. Furthermore, both mosquitoes and black flies become more or less inactive whenever the temperature drops to the neighborhood of 45° (*cf.* Weber, 1950: 196), and this happens fairly frequently even in mid-summer. Finally, the black flies retire during the hours of darkness; and short as these hours are, the relief they bring is very noteworthy. These conditions offer something of a contrast to those sur-

rounding the Woodland Caribou. It is difficult to see how that animal can secure a moment's respite from mosquito attacks, by day or night, through most of the summer. In its forested habitat there is not sufficient lowering of the temperature nor sufficient penetration of strong winds. Hard as the life of the Barren Ground Caribou may be, it seems to have a few advantages not available to the Woodland Caribou; and possibly it is these that have enabled it to attain a vastly greater population than the other species.

Of 52 mosquito specimens brought back from the Windy River area, 39 were *Aedes nearcticus* Dyar, 2 were probably *Aedes fitchii* (F. and Y.), and the remaining 11 were of the same genus but not in condition for specific determination (*cf.* Dyar, 1919; Weber, 1950: 196). *Ae. nearcticus* is holarctic in distribution; in North America it occurs chiefly on the Barren Grounds, but is known from as far south as Montana. *Ae. fitchii* ranges through the northern United States and Canada, north to the limit of trees. Of 26 black flies, all were *Simulium venustum* Say, which occurs in northern Europe, Alaska, and Labrador, south to the Adirondacks, Illinois, Iowa, Georgia, and Alabama. (Names and ranges supplied by Dr. Alan Stone, of the United States Bureau of Entomology and Plant Quarantine.) These mosquitoes and black flies were presumably the species attacking the Caribou in the Nueltin Lake region.

The effects of the two parasitic flies are felt nearly throughout the year. The adult warble fly (*Oedemagena tarandi*) is seen in the Windy River area in August, when the Caribou are on their southward march. On August 22 Fred Schweder, Jr., secured three of them on freshly killed Caribou and another that alighted on himself—all on an island in Windy Bay. His name for them is "deer fly." He reported seeing about 50 of them on this day (more than ever before), although he sighted only 10 Caribou. As he remarked, these fuzzy flies look much like bumblebees. Three days later, along Little River, something buzzed past me while a band of Caribou were near. It was probably this species, although it suggested a hummingbird almost as much as a bumblebee. On several subsequent August days, while numbers of Caribou were passing very close to me, I detected no more of the warble flies. In general, they might well have escaped my notice owing to my preoccupation with photography; but on August 30, when I looked for them on one of the nearest animals, I saw none. Evidently they are not sufficiently numerous (like horse-flies on cattle) to be constantly in attendance on each Caribou. In fact, a comparative scar-

city (or at least difficulty of capture) may be surmised from the fact that the Canadian Arctic Expedition 1913-18 brought back only three adult females—one from Teller, Alaska, and two from Bernard Harbour, Dolphin and Union Strait (Malloch, 1919: 55). Weber (1950) collected no Oestridae in Arctic Alaska.

Apparently there has been scarcely any published study of the egg-laying or other habits of the adult *Oedemagena* in relation to *Rangifer arcticus arcticus,* other than a few recent notes by Banfield 1951*a*: 31-32, fig. 17); but its behavior in relation to the Lapland Reindeer seems to be fairly well known, and it is summarized by Jacobi (1931: 245-246). In the case of the Reindeer, the fly's eggs are laid (during the summer) generally on the legs, belly, and tail region of the victim; the larvae, on hatching, bore through the skin, travel widely through the body, and finally (in the autumn) reach the place for further development—beneath the skin of the back on both sides of the vertebral column. Each one makes a breathing-hole through the skin, and uses this as an exit when leaving the host in the following June. Only the younger animals, from one to about four or five years old, are heavily infested; those still older are spared, possibly having learned to guard themselves better against the fly. Curiously enough, the fawns are said to escape this parasitism entirely.

My own observations on the larvae were restricted to a few Caribou specimens in June and in the autumn. As with the Reindeer, the Caribou fawns in their first autumn showed no visible infestation, as I noted in looking over some fresh hides on September 10, and as was noted again in a fawn of September 26. Fred Schweder, Jr., made the remark that larvae would be evident in the fawns by the following spring; this may indicate that the larvae have not, in the autumn, completed their journey to their final position on the Caribou's back. I learned of no immunity on the part of old adults.

Fullgrown larvae still remained in bucks secured on June 3 (fig. 17) and 18. According to Charles Schweder, they drop out in June. In the buck of June 3 there were perhaps several dozen warbles, each surrounded by a mass of repulsive tissue; in another buck of June 18, there were apparently more than 75. "It may be assumed," says Johansen (1921: 24), "that the pupae lie on the ground for about a month before the flies appear." He found (1921: 29) the adult flies abroad at Dolphin and Union Strait by July 14.

In a buck of August 17 the new warbles (or perhaps merely warble scars from the previous June—*cf.* Banfield, 1951*a*: 32) on the inside of the skin were not very numerous. Some were medium-sized, but most were so small that it was not deemed necessary to scrape them off; they had comparatively little fatty tissue about them and were merely allowed to dry up. The number of warbles (or warble scars) found in autumn specimens varied considerably, up to a maximum of roughly 200. They were situated mostly along the mid-dorsum, and more on the lower back or rump than farther forward. The number appeared to be approximately 130 in the skin of an adult doe that was nailed to the log wall of a cabin for drying on September 15 (fig. 18). A doe of September 21 seemed to have less than the usual number of warbles.

The nostril fly (*Cephenemyia*) is another serious dipterous parasite of the Caribou. The life history of the European *C. nasalis* (L.) (or *C. trompe* [L.]) and its effect on Reindeer are discussed by Bergman (1917), Natvig (1918), and Jacobi (1931: 245) as follows.

This fly attacks the host from June to September, depositing its viviparous larvae in the nostrils. The Reindeer attempts to fend off the fly, striking at it with its hoofs and keeping its nostrils closed as far as possible. Once deposited, the lively larvae crawl into the inner nasal passages and as far as the larynx, where they fasten themselves and live on the mucus. A Reindeer may harbor as many as 130 of these parasites. They range from 6 to 26 mm. in length. Their particular growth begins at the end of March, and they are ready for pupation up to May. The host assists their exit by continual sneezing and snuffling. In the last stages they are a great affliction for the host, and they sometimes cause its death. Pupation takes place in or on the ground, under some sort of cover, and it lasts for 15-19 days. The flies have been found emerging from July 12 to 31.

The corresponding parasite of the Barren Ground Caribou is a similar or perhaps identical species, with a parallel life history. Its chief activity as an adult doubtless occurs in July and August. A number of the mature larvae were found in the throat of the buck of June 3; two of them that were preserved measure approximately 7 mm. in diameter and 27 and 30 mm. in length. A large mass of such sizable parasites in the throat might easily become a serious obstacle to comfortable living or even to survival on the part of the host. Presumably the larvae drop to the ground at about the

same period as those of *Oedemagena*. Fred Schweder, Jr., remarked concerning the buck of August 17 that these larvae are never found at that season, and Charles Schweder made the same remark concerning a doe specimen of September 21. It would appear either that they remain so small as to escape detection at this time or that they do not reach the throat on their short journey from the nostrils until some later period of the year. Johansen (1921: 24) records larvae only 2-3 mm. long in the nasal passage at the end of May.

Since the bulk of the Caribou population has passed well to the northward of the Nueltin Lake region by the time the larvae of *Oedemagena* and *Cephenemyia* drop out of the bodies of their hosts to pupate briefly on or in the ground (say in the latter part of June), one is tempted to speculate on the possibility that the adult flies found here in August may have followed their prospective victims for many miles in their southward migration. However, Porsild remarks (1943: 386) that they "apparently do not travel very far."

Certain kinds of behavior exhibited by the Caribou in attempting to fend off the parasitic flies are discussed in the section on *Shaking off moisture and insects.*

The adults of *Oedemagena tarandi* (L.) were determined by Mr. C. W. Sabrosky, of the Bureau of Entomology and Plant Quarantine; and the larvae of *Oedemagena* and *Cephenemyia* by Dr. W. W. Wirth, of the same bureau. The larvae of the latter genus are regarded as probably *C. trompe* (L.); they were new to the collection of the United States National Museum.

References.—Hearne, 1795: 197; Franklin, 1823: 241; Richardson, "1825": 328-330, and 1829: 242; Godman, 1831, **2**: 284; Murray, 1858: 210; B. R. Ross, 1861: 438; Pike, 1917 (1892): 58-59; J. B. Tyrrell, 1892: 128, and 1894: 442; Whitney, 1896: 239; Russell, 1898: 228-229; Jones, 1899: 411; Hanbury, 1900: 67, and 1904: 32, 137, 194; Preble, 1902: 41; R. M. Anderson, 1913*b*: 504; Stefánsson, 1913*b*: 204, 212-213, 333; Douglas, 1914: 191-192; Malloch, 1919: 55-56; Hewitt, 1921: 67; Johansen, 1921: 22-24, 29, 35, 37; Stefánsson, 1921: 247; Blanchet, 1925: 32, and 1926*b*: 47; Birket-Smith, 1929 (1): 56, 133; Seton, 1929: **3**: 109-11; Critchell-Bullock, 1930: 193; Hoare, 1930: 33, 37-38; Kitto, 1930: 89; Jacobi, 1931: 244-245; Munn, 1932: 58; Sutton and Hamilton, 1932: 84-86; Birket-Smith, 1933: 90, 92; Ingstad, 1933: 48, 135; Hornby, 1934: 105; Soper, 1936: 429; Henriksen, 1937: 25, 26; Hamilton, 1939: 247, 301; Murie, 1939; 245; Clarke, 1940: 70, 95; Downes, 1943: 226, 255; Manning, 1943*a*: 53; Porsild, 1943: 386; Gavin, 1945: 228; Harper, 1949: 228; Banfield, 1951*a*: 31-33; Barnett, 1954: 104.

Ectoparasites

It was in vain that I searched a number of fresh specimens for lice, mites, fleas, or ticks. The Schweder boys spoke of never having noticed any such parasites. Seton (1929) mentions none, and

Jacobi (1931: 243) records only a louse (*Linognathus tarandi*) from the Reindeer. "Lice are not known from caribou according to Ferris (in conversation)" (Weber, 1950: 154).

Relations to Reindeer

Recent discussions of the possibility or advisability of introducing domesticated Reindeer to replace, or to augment the diminishing supply of, native American Caribou in various new localities prompt a brief review of the subject.

It may be remarked at the outset that acclimatization attempts in the Old World have generally been abortive. Wild Reindeer introduced from Finmark into Iceland in the eighteenth century flourished for a time, but by 1917 they were almost exterminated. A number of different introductions into Great Britain, Denmark, Germany, Austria, Switzerland, and Italy came to naught. On the other hand, the introduction of Lapland Reindeer on the subantarctic island of South Georgia in 1908 seems to have turned out successfully. (Jacobi, 1931: 158-165; Harper, 1945: 473-474.) A saving feature in each of the above-mentioned cases was the absence of any native Reindeer whose racial purity might have been destroyed by the newcomers.

Decrease of local American stocks of Caribou, and consequent suffering of native populations who had in past generations depended upon these animals for a major portion of their food supply, have led to introduction of foreign Reindeer in several regions of North America, from Newfoundland and Labrador in the east to Alaska in the west. The persons responsible were doubtless inspired by high humanitarian motives; but it is doubtful if they could have thoroughly considered or foreseen the serious biological consequences of their efforts.

In Alaska, importation of domesticated Siberian Reindeer began in 1892. By the 1930's the herds had increased to an estimated total of 600,000. For various reasons, however, the industry has so far declined that by 1949 the total number of Alaskan Reindeer had become reduced to about 28,000 head. Disinclination of Eskimos for reindeer-herding and mixture of their stock with wild Caribou were important reasons for this decline. (Lantis, 1950.) From the biologist's point of view, the most unfortunate result was the large-scale interbreeding with the native Grant's Caribou (*Rangifer arcticus granti*) and the progressive extermination of that fine animal in a pure form by dilution with inferior alien blood. Among Alaskan

Reindeer, "constant inbreeding has led to a noticeable reduction in the prolificness of the females, and degeneration is to be observed in many herds" (Hewitt, 1921: 323).

In 1908 Dr. Wilfred T. Grenfell brought 300 Lapland Reindeer to Newfoundland. After some years they were transferred to the north shore of the Gulf of St. Lawrence and finally to the island of Anticosti. (Hewitt, 1921: 324-328; Seton, 1929, **3**: 92.) In 1911, 50 of these Reindeer were shipped from Newfoundland to the Slave River region. Most of them escaped (probably to contaminate the local stock of Caribou), and by 1916 the last survivor of this band in captivity had succumbed (Hewitt, 1921: 329-330).

"A large part of the reindeer in Alaska are south of the Arctic Circle on the comparatively mild shores of Bering Sea, where there are several months of open tidewater navigation; vegetation is more luxuriant [than in Arctic Canada] and conditions easier in general. There the reindeer were introduced into a country where the wild caribou had been virtually exterminated, and a large native population were anxious to take up a new mode of support. The percentage of profits has appeared unduly large in Alaska because statisticians have been unable to take into account the value of the services of a large body of devoted missionaries, government teachers, and other unselfish persons who put their best efforts into years of unpaid extra work to make the reindeer successful and beneficial to their charges.

"Canada has a large area of Arctic and sub-arctic lands beyond the reach of possible cultivation, still occupied by large numbers of wild caribou and remnants of musk-oxen, with native inhabitants who derive a living from them and add to the national wealth by fur production. These Indians and Eskimos are still far from being either able or willing to enter upon a pastoral stage of existence, and moreover, they are now enjoying an era of prosperity from the fur industry which may be temporary, but which they will not relinquish for the slower and less profitable prospects of the herder." (R. M. Anderson, 1924: 330-331.)

In 1921 some Norwegian Reindeer were landed at Amadjuak, Baffin Island (Seton, 1929, **3**: 92). The lack of further reference to the Baffin Island animals by such subsequent investigators as Manning and Soper would seem to indicate that the reindeer have not survived, unless through mixture with the native Caribou. An attempt in 1922 at acclimatization in Michigan "ended in total failure" (Seton, 1929, **3**: 93).

"The Barren Grounds . . . still feed enormous herds of caribou . . . . The greatest danger to this industry [reindeer-raising] is just these wild herds, which would be very apt to absorb the tame animals. This problem may perhaps become a fatal one to the Eskimos, for there might very easily come a most difficult transitional period, when the caribou would be too few in numbers to form a definite basis for the existence of the people, but on the other hand numerous enough to make reindeer breeding difficult." (Birket-Smith, 1933: 121.)

In northwestern Alaska "large numbers of reindeer are constantly escaping the herders and joining the wild caribou. It seems that it will be but a short time until there will be no pure bred caribou along that part of the coast. . . . As the reindeer are protected, and the caribou are killed at every opportunity, the former will doubtless prove the dominant animal and in time overcome the caribou, with hybridization the inevitable result." (Bailey and Hendee, 1926: 22.)

"The caribou's greatest menace is not the wolf, nor the hunter, but man's economic developments, principally the raising of reindeer. Wherever reindeer herds are introduced, caribou must of course disappear, for both cannot occupy the same range. The disappearance of the caribou along the Bering Sea and Arctic coasts, while regrettable, was unavoidable in view of the development of reindeer herding in this section, which is ideal for the purpose. . . .

"The mingling of reindeer with the main caribou herds should be avoided. Reindeer herds maintained in close contact with migrating caribou suffer frequent losses through strays. Already the domestic reindeer are mingling with the caribou herd of Mount McKinley National Park . . . . [Hybridization] would be regrettable in interior Alaska, which has produced a splendid type of wild caribou, coming near at least to being the largest on the continent." (Murie, 1935: 7.)

Murie's extensive experience with these animals in Alaska has led him to remark further (1939: 245):

"The greatest hazard to the Caribou is the possible occupation of the range by man's agricultural activities. . . . The most serious danger is introduction of domesticated Reindeer on wild Caribou range, for the wild herds must be removed in order to make possible the safe herding of the domestic animals. . . . There is not room for both of these animals on the same or closely adjacent ranges."

Porsild points out (1943: 386, 389) that sparsely covered graz-

ing areas are suitable for Caribou but not for Reindeer; and that the former disappear before expanding Reindeer culture.

"Perhaps the worst threat of all to the caribou has been the introduction of reindeer culture along the arctic coast. This has resulted in interbreeding between the wild caribou and their inferior domesticated relatives. When and if this mixture extends to all the herds of the Barren Grounds, the caribou may be written off the record as a pure species; the animal will have become extinct through dilution, as the biologists express it." (Harper, 1949: 239.)

The American Society of Mammalogists, at its annual meeting in 1950, passed the following resolution (*Jour. Mammalogy* **31** (4): 483, 1950):

"That the American Society of Mammalogists urges that the Canadian Government not undertake the introduction of reindeer into Ungava. Before any introduction even is seriously considered, those persons involved in any planning are urged to make a thorough study beforehand of the problems of integrating lichen ecology, reindeer biology, and native culture—serious problems that have not been solved to date on any workable scale on the North American continent. It would be particularly deplorable if an introduction, to aid the natives, led to early successes and high hopes, then eventual failure."

Porsild, who knows the Reindeer thoroughly at first hand, has made (1951: 53) the following observation:

"Thus far these experiments [at introduction into America] have met with only partial or indifferent success, because reindeer nomadism is incompatible with present trends of cultural development and because the North American Arctic is too thinly populated to provide a ready market for reindeer products."

Referring to the region of the Brooks Range in northern Alaska, Rausch says (1951: 190):

"The mixture of inferior reindeer bloodlines with the native caribou is serious. This has already occurred to a considerable degree, and it is hoped that proper control will be exercised if the reindeer industry is revived in Alaska. Ear-notched animals have been killed in the Anaktuvuk Pass country, and white reindeer have been seen running with the caribou. The number of unrecognized reindeer passing through could be great."

At present the Barren Ground Caribou is apparently the third most abundant member of the deer family on our continent, being exceeded by the White-tailed Deer and the Mule Deer (*cf.* Jackson,

1944: 7-8). No other member of this family could be expected to be so eminently and thoroughly adapted to its Arctic environment or to thrive so well on the very ground where nature has been molding and perfecting its characters for thousands of years. No naturally occurring relative—Moose, Deer, or Woodland Caribou—undertakes to compete with it on its own particular range. It requires practically nothing for the maintenance—and increase—of its present numbers, other than an enlightened policy of conservation. (As indicated on a previous page, the feminine wearers of Arctic Fox furs must bear a heavy share of responsibility for the decline of the Barren Ground Caribou in recent decades.) Our highest authorities have pointed out the impracticability of Caribou and Reindeer occupying the same range.

Would it not be the part of wisdom to exclude the inferior domesticated alien, with its difficult and generally unsuccessful culture in North America, and thereby to give the wonderful wild Caribou of the Barrens its best chance for survival?

References.—Chambers, 1914: 350-351; Hornaday, 1914, **2**: 105-108; Hewitt, 1921: 323, 329-330; R. M. Anderson, 1924: 330; Kindle, 1928: 74; Seton, 1929, **3**: 92-93; Blanchet, 1930: 53-54; Birket-Smith, 1933: 121; Godsell, 1934: 276; Murie, 1935: 7, 1939: 245-246, and 1941: 435; Porsild, 1943: 386, 389; Rousseau, 1948: 96; Harper, 1949: 239; Polunin, 1949: 24; Lantis, 1950; Hustich, 1951; Porsild, 1951: 53; Rausch, 1951: 190; Scheffer, 1951.

Numerical Status

There seems to be a general impression, among those who have known the Barren Ground Caribou at first hand for a considerable period, that the population has been reduced by something like a half during the past generation. "Recent preliminary aerial survey has indicated that their numbers, although less than the previous estimates of 3,000,000 (R. M. Anderson, 1938; Clarke, 1940), which were based upon the carrying capacity of the Arctic tundra, are probably comparable to their primitive numbers in the central portions of the range" (Banfield, 1949: 478). A definite reduction is indicated along the Arctic coast and on the Arctic islands (R. M. Anderson, 1937: 103, and 1938: 400; Banfield, 1949: 478, 481, and 1951*a*: 13-14). While large numbers still remain in southwestern Keewatin, there are no reports of any such mass occurrence as was witnessed by the Tyrrell brothers on the upper Dubawnt River on July 29, 1893; that throng was estimated at 100,000 to 200,000 animals (J. B. Tyrrell, 1897: 165).

During the big movement of the last week of August, 1947, I may have seen as many as 500 Caribou on one or two days, in herds

numbering up to 150 individuals. A striking proportion of those observed seemed to occur in bands of roughly 25 animals. On August 25 Fred Schweder, Jr., reported about a thousand crossing Little River, in bands of as many as 100 individuals. On October 11 Charles Schweder observed a thousand Caribou resting on a hill 3 miles long in the vicinity of Four-hill Creek. In November he found thousands, in herds up to 300 strong, moving south from the upper Kazan River. These figures may give a faintly approximate idea of the numbers occurring in the general region of Nueltin Lake in a year considered less good than an average one. On the other hand, toward the coast of Hudson Bay, there were reports of a greater number of autumn migrants than in ordinary years.

In October, about 1944, tracks indicated that 2,000 or 3,000 animals had crossed Windy River in the vicinity of Four-hill Creek in the night (*fide* Charles Schweder). About October 10, 1946 (a year of unusual abundance), Fred Schweder, Jr., witnessed the passage of thousands in one day in this vicinity; he got the impression of "the hills moving with Deer." (Yet this was the season when the Caribou passed mainly to one side of the upper Kazan River, so that nearly one-third of the local band of Eskimos starved to death.) In the first part of May, about 1942 or 1943, John Ingebrigtsen came to a nameless lake, about half a mile by a mile and a half in extent, somewhere east of Duck Lake, Manitoba. It appeared "absolutely full of Caribou," and he estimated their number at not less than 20,000. This would mean a density of no more than about 50 per acre.

References.—Jones, 1899: 368, 374; J. B. Tyrrell, 1894: 442, and 1897: 10, 49-50, 165; Whitney, 1896: 240; Seton, 1911: 220, 258-260; R. M. Anderson, 1913*b*: 502: Hornaday, 1914, **2**: 225-226; Nelson, 1916: 460; Thompson, 1916: 100-101; Kindle, 1917: 108-109; Buchanan, 1920: 130-131; Hewitt, 1921: 56, 64-66; Stefánsson, 1921: 255; R. M. Anderson, 1924: 329; Blanchet, 1926*b*: 48, and 1930: 52; Kindle, 1928: 72-73; Seton, 1929, **3**: 131-134; Critchell-Bullock, 1930: 159-160; R. M. Anderson, in Hoare, 1930: 52-53; Kitto, 1930: 87; Jacobi, 1931: 201-202; Munn, 1932: 58; Birket-Smith, 1933: 89; Ingstad, 1933: 160; R. M. Anderson, 1938: 400; Clarke, 1940: 65, 84-91, 101-104; Downes, 1943: 258-260; Wright, 1944: 185-188, 191, 193; Yule, 1948: 287-288; Banfield, 1949: 478, 481, and 1951*a*: 9, 13-14; Harper, 1949: 231, 239; Anonymous, 1952: 261; Barnett, 1954: 96.

General Habits

Daily periods of activity and rest

According to Charles Schweder, the Caribou do not move about much at night; that seems to be their principal time for sleep. They exhibit a definite tendency to pause and rest also toward the middle of the day. Several instances have already been given

of the animals resting at such a time on frozen lakes and rivers: lakes southwest of Reindeer Lake, March 18; lakes south of Lake Athabaska, April 16; Seal River, May 31; Windy Bay, June 6 (mid-morning). Open hilltops are evidently sought likewise for both nocturnal and mid-day rests: knoll by Windy River, June 3; Josie's Hill, June 20; ridge by Little River, August 24 (about 9 a.m.). (For details, see sections on *Winter range, Spring migration,* and *Fall migration.*)

Although we noted a small band of Caribou passing through a thick and extensive stand of spruce at dusk on October 2, Fred Schweder, Jr., remarked that they do not rest in such a place; they are safer from Wolves in open areas. Charles Schweder reported about 50 Caribou, in three slightly separated bands, appearing on the south side of Windy River near Four-hill Creek during the evening of September 24, but not making up their minds to cross; he thought they might have been scared by Wolves. Possibly there was a similar explanation for the crossing of the river at this point by large numbers of the animals during an October night several years previously.

According to Fred Schweder, Jr., a day's movement of Caribou past the mouths of Little and Windy rivers during the fall migration generally does not commence before 10 a.m. and ends about 3 p.m. The explanation of such a phenomenon is none too obvious; and in any event, there were exceptions enough, though the general statement may hold true for the bulk of the migrants. As remarked in the section on *Spring migration,* the daily periods when the Caribou crossed the ice of Windy Bay were mainly from 10 to 11 a.m., from 2:30 to 5 p.m., and in the evening.

On August 27, about 5:50 p.m., a majority (say half a dozen) of a small band of Caribou were lying down on a slope near the mouth of Little River. They faced down wind to watch for enemies in that direction, while their noses would warn them of any approaching from the opposite direction. Their attitude was very much like that of Norway Reindeer figured by Seton (1929, **3**: pls. 11, 15, 18).

Charles Schweder spoke of having seen whole herds lying down to rest, while none of the animals remained standing up on guard. He had noted one such herd of 600 or 700 along the Thlewiaza River in August. He further stated that when the Caribou lie down to rest and to chew the cud, they hold the head up. They may also sleep in this position. In the hard winter of 1944-45, when the snow

was deep and the animals were tired and hungry, he came up to a resting herd. All but one of them got up and moved away. That one remained sleeping, head up and eyes closed; Charles walked up to within 10 feet and shot it. He has also seen resting Caribou lay their heads down on the side, but only for a few moments at a time.

References.—J. B. Tyrrell, 1892: 129; Jones, 1899: 359; Harper, 1949: 227; Banfield, 1951*a*: 23.

Organization of herds

The Barren Ground Caribou is a distinctly gregarious species. It goes in herds for at least the greater part of the year; this is especially true of the spring and autumn migration periods and of the winter months. We know comparatively little of the behavior of the does at fawning time in June; but probably there is a tendency toward solitariness on their part at that season. It is true that solitary Caribou may be met with at almost any season of the year; but this doubtless represents merely temporary rather than permanent segregation of such individuals. At the very end of the spring migration and at the beginning of the autumn migration, there may be, among the sparse southernmost elements of the population, a larger proportion of solitary animals.

While marching over the Barrens and feeding as they go, the smaller bands maintain a fairly loose organization, as apparently best suiting their needs. On the other hand, the huge herds of former times, such as the Tyrrells met on the upper Dubawnt in 1893 (J. B. Tyrrell, 1897: 49-50, pl. 1; J. W. Tyrrell, 1908: pls facing pp. 80, 81; Seton, 1929, **3**: pl. 22), obviously maintained very compact ranks. In my limited experience, the animals bunched more closely in crossing the rivers than was normally the case on land among feeding herds. While swimming, they would follow each other in files at minimum intervals; but in stepping across rapids they might extend these intervals somewhat.

When merely covering ground, without stopping to feed, or when following a trail through brush or along a narrow ridge, there is a strong tendency for the animals to go in a single file, or at least in a procession many times longer than wide. This was also apparent when they were crossing the ice of Windy Bay in June.

When Caribou flee from some source of alarm, a distinct tendency toward compact bunching may be observed. This may have been developed as a measure of protection from pursuing Wolves; the latter could naturally overcome a straggling or isolated individual more readily than one in a compact herd. The Caribou running

away from the train in the "Little Barrens" south of Churchill very clearly demonstrated the tendency toward a close formation. (See also, in the section on *Disposition*, the account of a herd attacked by a hunter near Lake Charles.)

The larger herds of the autumn migration seemed to be generally composed of all sexes and ages; yet some sizable bands were made up chiefly of bucks on the one hand, or of does and fawns on the other hand. The rear guard of the spring migration and the vanguard of the autumn migration are generally composed of bucks, traveling either singly or in small bands; this state of affairs is looked upon as evidence that the majority of the bucks do not advance so far to the north in June and July as the does do.

The following are a few examples of the composition and leadership (or rear-guarding) of groups of Caribou. (Other examples are mentioned in the sections on *Migration.*) A band of about 20, after feeding for a time on the south bank of Windy River on June 16, moved off upstream, mostly in single file, with a patriarchal buck in the lead. The remainder of the band included several lesser bucks and various does and yearlings. On the following day a band of equal size, composed chiefly of bucks but including three hornless individuals (does?), was led by two of the bigger bucks. When a band of some 40 does and fawns approached Little River to cross it on August 25, a doe came first to the water's edge to make a careful inspection. On the same day I remarked having noted several times that a buck brought up the rear of a band. On August 26 I noted that a distinct majority in the herds of the previous two or three days were does and fawns, although there were generally a few bucks present also. At this period I got the impression that the number of individuals in a band was frequently not far from 25. On August 28, when a band of 40 crossed the mouth of Little River, three or four bucks plunged in first, but a doe was almost even with them. At the Bear Slough, on September 3, a group consisted of two bucks, two does, and a fawn. On September 15 Fred Schweder, Jr., reported seeing about 100 Caribou, with not a buck among them. On September 24 about 15 does and fawns were resting or feeding quietly by Glacier Pond. On September 28 a band of six large bucks crossed the Camp Ridge. On October 1, an older and a younger buck appeared in the shoal waters of Duck Bay. On November 3, in the same locality, a band of about 50 was composed largely of does, but included a few fawns and a few well-antlered bucks. On

November 11 five does were reported crossing the mouth of Windy River on the ice.

Charles Schweder remarked that the leader of a band is generally a doe; but sometimes it is a buck, or even a fawn. There is virtually no way of telling whether the same doe habitually leads a band. In the big migrant herds, bucks bring up the rear. Once in September, in a herd of about 100 animals, the front half was composed of does and fawns, the rear half of bucks. In the rutting season the does are naturally in the lead, the bucks following them.

References.—Hearne, 1795: 198; Richardson, "1825": 329; Simpson, 1843: 277, 281, 381; J. Anderson, 1856: 24, and 1857: 324; Schwatka, 1885: 83; Pike, 1917 (1892): 49, 174, 204, 209; Dowling, 1893: 107; Stone and Cram, 1904: 52; Blanchet, 1925: 32-33, and 1926*b*: 48; Critchell-Bullock, 1930: 192-196; Hoare, 1930: 13, 33, 37; Kitto, 1930: 88; Mallet, 1930: 20-23; Jacobi, 1931: 190, 203-204; Hornby, 1934: 106; Birket-Smith, 1936: 112; Hamilton, 1939: 247; Clarke, 1940: 95; Downes, 1943: 256; Manning, 1943*a*: 52; Harper, 1949: 228, 229; Banfield, 1951*a*: 23-26.

Disposition

The Barren Ground Caribou comes close to holding the palm for unwariness among the larger land mammals of North America. It is fortunate that its range lies so far from the centers of civilization. It is scarcely conceivable that it could survive, as the White-tailed Deer does, in some of our most thickly settled areas. At the river crossings, where I watched the pageant of migration for day after day, some of the animals would come up to within a rod while I handled my cameras in the open, with no more cover than knee-high bushes and rocks (figs. 11, 14). Where else, among the larger creatures of the wilderness, could one find such a close approximation to a Garden-of-Eden existence? Until they detected the human scent, they would stare at me at such close quarters with little more concern than so many barnyard cattle. (For examples, see the section on *Fall migration.*) Moreover, there were occasions when they must have gotten my wind and still did not show panic. There is an obvious deficiency of eyesight or judgment, or both.

To account for their behavior on such occasions, I speculated as follows. The species has scarcely any predatory enemies save man, the Wolf, and (perhaps to some extent) the Wolverine. In their normal experience, any such enemy, if within close range, would be making an attack. Thus a questionable figure, not becoming evident to them until they are within close range, and then making no motion to attack, may be dismissed by them as something different and therefore harmless.

The attitude of unconcern has probably been developed in

past generations through the habit of the Caribou of traveling in vast throngs. The threat of danger to a given individual in a herd of, say, 100,000 is practically negligible. From time immemorial the river crossings have represented a particular point of attack on the part of the natives. Yet when a large band of Caribou come to such a crossing, they may plunge in with little pause or hesitation. On the other hand, when a lone doe with her fawn approaches the river bank, she may be very circumspect, taking time to look carefully upstream and down, and across, before venturing into the water. I also saw another doe with a fawn exercise similar precaution, when she was merely the first of a band of 40 to reach the river's edge. It is probably concern for her fawn that renders a doe more circumspect than a buck.

When Fred Schweder, Jr., was endeavoring to intercept a Wolf on September 6, a fullgrown buck came feeding around a tree within 10 feet of him. The animal winded Fred without apparently seeing him, and went back and forth uncertainly for about a minute; finally it moved off very slowly.

Stefánsson's account (1913*b*) of his various adventures with Caribou near the Arctic coast of Mackenzie indicates a far wilder animal in that region than the one in Keewatin. It appeared a great deal easier for me, with no particular effort at caution, to get within photographic range (say a dozen feet to 50 yards) than for him to approach within rifle range (several hundred yards).

Even after being fired upon, a single animal or a band in the Nueltin Lake region will rarely put distance between themselves and a hunter with all possible dispatch, as an alert White-tailed Deer would, but will run hither and thither in confusion, with frequent pauses to display their befuddlement. On October 8 I was a distant and saddened spectator of a scene of slaughter. A hundred or more Caribou were resting or feeding quietly on a bare ridge south of Lake Charles. They were distributed in a narrow formation, 75-100 yards long and from one to several animals deep. A hunter, approaching close to the south end of the herd, began firing. With one accord they made toward the north, but very shortly executed a sharp turn and came back rapidly in the opposite direction, passing in a narrow, compact column within 30 feet of the hunter, who continued shooting. In 200 or 300 yards they paused and allowed the hunter to come up with them and resume shooting. The process was repeated over a distance of three miles; but the pursuer now and then circled ahead of the herd instead of follow-

ing in its tracks. The final toll: 29 Caribou hit and 22 or 23 secured —virtually a quarter of the herd destroyed and most of it to be used for dog feed.

It is said that the attachment between a doe and its fawn is such that when one of them is killed, the hunter can approach within 50 feet of the surviving doe or within 20 feet of the surviving fawn. A fawn is apt to linger for days in the vicinity where its dam has been killed.

Charles Schweder has never seen fawns playing with each other or with their mothers; two or three times he has seen one frisking by itself—such as jumping about or running in a circle—but never for more than half a minute at a time. Seriousness of life for a Caribou seems confirmed from its infancy.

In the hard winter of 1944-45, when the Caribou were tired and hungry, Charles had the rare experience of driving his dogteam right through herds on Nueltin Lake; the animals merely moved aside enough to let him pass. In like vein Joe Chambers spoke of encountering such numbers of migrating Caribou on or near the "Little Barrens" south of Churchill in the spring of 1947 that his dogs "went wild" and he had to halt for a time; the animals came within about 100 yards of his team.

A Caribou bold enough to attack a man is very rarely heard of. Yet that was the experience of 15-year-old Anoteelik on September 8. Having run out of ammunition, he undertook to kill a 2-year-old buck with a rock in a patch of timber. (Possibly the animal had already been wounded with Anoteelik's .22 rifle.) When the missile failed of its mark, the buck made for the boy, who escaped by climbing a tree. Perhaps this is the first case on record of a man or a boy (especially an Eskimo!) being treed by a Barren Ground Caribou. Jenness mentions (1922: 150) a case of an Eskimo being fatally gored by a Caribou on Victoria Island. Otherwise, under all general circumstances, and in contradistinction to the Bison, the Muskox, the Moose, and even the White-tailed Deer, the Caribou may be regarded as quite innocuous to man.

The restlessness so frequently exhibited by Caribou during the summer, in trotting rapidly over the Barrens or in feeding hurriedly here and there while constantly forging ahead (in contrast to the placidity of grazing sheep and cattle), may be attributed in large part to the relentless scourge of fly pests.

(See also *Relations to man.*)

References.—Lyon, 1824: 336-337; J. McLean, 1932 (1849): 359; Simp-

son, 1843: 207; Armstrong, 1857: 478-479, 481-482; Gilder, 1881: 78; Schwatka, 1885: 85; Pike, 1917 (1892): 51-52, 90; Whitney, 1896: 242; Hanbury, 1904: 85; Amundsen, 1908, **1**: 103; Stefánsson, 1913*b*: 278, and 1921: 251; Hornaday, 1914, **2**: 104; Jenness, 1922: 150; Blanchet, 1925: 34; Birket-Smith, 1929 (1): 106; Seton, 1929, **3**: 105-107; Jacobi, 1931: 219, 220; Ingstad, 1933: 88, 293, 297; Downes, 1943: 236-237; Porsild, 1943: 389; Harper, 1949: 229-230; Banfield, 1951*a*: 22.

Senses

There is fairly general agreement on the Caribou's keen sense of smell, good hearing, and less well-developed vision. But perhaps the last-mentioned attribute does not so much constitute poor eyesight as lack of *perception* or *recognition*. In other words, is it not possible that the animal is merely deficient in interpreting what it may see clearly enough?

References.—R. M. Anderson, 1913*a*: 8, and 1913*b*: 504; Stefánsson, 1913*b*: 164, 1914: 58, and 1921: 307; Blanchet, 1925: 34, and 1926*b*: 48; Birket-Smith, 1929 (1): 106; Seton, 1929, **3**: 104; Murie, 1939: 245; Banfield, 1951*a*: 22.

Gaits

The three principal gaits of the Caribou are walking, trotting, and loping. The animal seems to be in such a constant hurry that trotting is fairly habitual. The speed of this gait varies with the urgency of the occasion; also, according to Stefánsson (1921: 248), with sex and age. When frightened by an enemy, a Caribou may start off with a loping gait, but it soon settles down to its space-consuming trot, which keeps it safely ahead of a Wolf in any brief chase. The initial leap takes all four feet off the ground at once (*cf.* Buchanan, 1920: 126). According to Charles Schweder, it is usually a single animal that reacts in this way; but he has seen as many as six together leaping into the air. Fred Schweder, Jr., has seen both bucks and does in this performance. My own observations covered two lone adults (at least one a buck) and a lone fawn. One of the former turned and took a step or so before making the leap. The fawn (at Simons' Lake in October), after allowing a canoe to approach within 100 feet, started off twice in succession, and each time with an initial leap into the air before settling down to a trot.

Even a summer fawn is reputed to be able to outdistance a Wolf. Lyon (1824: 67) found a Caribou too fleet for a greyhound.

In trotting rapidly, a Caribou points its snout pretty straight to the front, thus tilting the antlers backward a little. This gait, with front legs stretching well out in front and hind legs thrust backward correspondingly, gives a very characteristic and distinctive

stamp to the appearance of a fast-trotting Caribou. (Compare the sketches of trotting Norway Reindeer by Seton, 1929, **3**: pls. 15, 18.) It is apparently quite different from any normal gait of the White-tailed Deer. A buck's well-grown antlers are of such weight as apparently to force it to hold its head rather rigidly while going at speed. If its head swayed appreciably, the top-heavy antlers might tend to throw the animal off balance. In a trotting gait, the hind foot may be planted just beyond the spot where the front foot had rested. In walking, the print of the hind foot may be superimposed on that of the other (fig. 20). The white "spats" just above the hoofs show to fine advantage when the Caribou trots; they fairly twinkle. In a retreating animal the white rump-patch appears in marked contrast to the dark brown adjacent fur.

In stepping across a shallow rapid in peaceful surroundings, the rhythmic splashings of the water to the front and the sides of the alternately descending hoofs make a scene of rare charm. In moving through deeper water, where the bottom is rough, rocky, and slippery, the animals may pick their way quite slowly. When alarmed near the water's edge from some such cause as detecting a human scent, they may make great splashing leaps into a river or bay, fairly enveloping themselves in huge clouds of spray. There can be few more spirited scenes of animal life in the North.

I have seen several of the animals running with open mouths, even when they had gone no more than a quarter of a mile from a point of alarm. Every now and then a Caribou will be seen limping —perhaps from wounds, perhaps because of a leg sprained in rough terrain.

References.—Lyon, 1824: 67; Osborn, 1865: 227; Russell, 1895: 50, and 1898: 90; Hanbury, 1904: 131; Nelson, 1916: 460; Buchanan, 1920: 126; Stefánsson, 1921: 248; Blanchet, 1925: 33, and 1926*b*: 47; Critchell-Bullock, 1930: 193; Sutton and Hamilton, 1932: 83; Ingstad, 1933: 87; Murie, 1939: 245; Downes, 1943: 236-237; Harper, 1949: 226, 229; Banfield, 1951*a*: 21.

Tracks

Caribou trails, resulting from the impact of countless hoofs on the same restricted courses for unnumbered years, have been discussed in the section on *Ecology*. The placing of the feet has been touched upon in the section on *Gaits*. The individual tracks remain to be considered.

Each of two foot-prints photographed in mud was approximately 4 inches (102 mm.) long and 4½ inches (114 mm.) wide. Another such photograph (fig. 19) shows tracks about 114 by 95

and 102 by 102 mm. The foot sketched by Seton (1929, **3**: 129) is obviously a front foot, though not so labeled; the hoofs as drawn are approximately 89 and 93 mm. in length; the width of the foot is approximately 100 mm.

A track (fig. 20) photographed in 2-inch snow represents a hind foot-print superimposed upon a front foot-print in a walking gait; including the marks of the dew claws, it was approximately 6 inches (153 mm.) long and 5 inches (127 mm.) wide. The "square-toed" appearance is very characteristic.

A front hoof is a little broader as well as longer than a hind hoof (fig. 24). The extreme and average lengths of the front hoofs in five of my adult male specimens are 80-92 (85.2); of the hind hoofs, 74-84.5 (79.8). In an adult doe a front hoof measures 77; a hind hoof, 72.

Reference.—Banfield, 1951*a*: 19.

Swimming

In their extensive and long-continued migrations over a territory composed in large part of lakes, ponds, and rivers, the Caribou have almost daily need, from June to October, of surmounting these barriers by swimming. The low temperature of the water seems to have no deterring effect on them. Yet it appears that some of the animals may fail in attempting the passages of wide waters. Charles Schweder spoke of finding a number of dead Caribou, including bucks as well as fawns, that had apparently succumbed in crossing a 4-mile-wide lake on the Thlewiaza River. (Or had they perhaps come to grief in some upstream rapid and finally been washed ashore on the lake?) Bones on the shore indicated that this sort of tragedy might be more or less of an annual occurrence. Perhaps some of the victims had been wounded or were otherwise in poor condition.

The buoyant, hollow hairs of a Caribou's coat enable the swimming animal to keep almost the whole median dorsal line of its body perhaps 2 or 3 inches above the surface (figs. 9, 12). In a doe noticed on August 28 the lowest point on the top of the neck, just in front of the shoulders, was practically level with the surface, but elsewhere the dorsal line, from snout to tail, was out of the water. In both doe and fawn the head is held so high that the lower side of the snout at the tip does not touch the water; in the older bucks of the autumn, however, the weight of their antlers presses the head down until the lower side of the snout is frequently in contact with

FIG. 19. Caribou tracks in mud; one about 114 by 95 mm.; another, 102 by 102 mm. Between Bear Slough and Eider Pond, September 3, 1947.

FIG. 20. Caribou track in 2-inch snow; hind foot superimposed on track of front foot. Combined track about 153 by 127 mm. Camp Ridge, October 29, 1947.

FIG. 21. A Caribou doe (specimen No. 1101). Mouth of Windy River, September 21, 1947.

FIG. 22. A Caribou buck (specimen No. 1111). Mouth of Windy River, September 29, 1947.

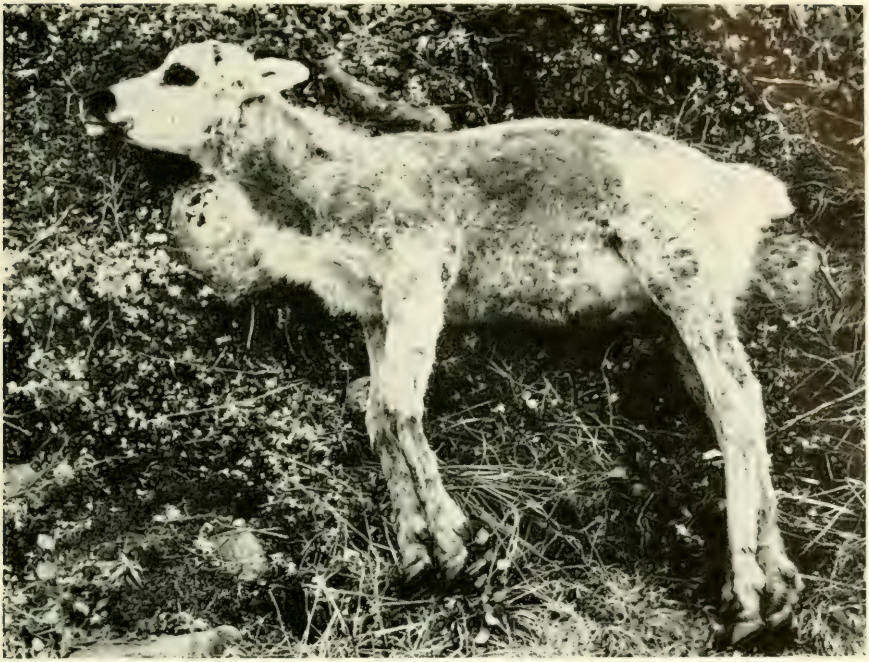

FIG. 23. A male Caribou fawn (specimen No. 1095), in its first, woolly pelage. Mouth of Windy River, September 7, 1947.

FIG. 24. Hoofs of a male Caribou fawn (specimen No. 1072); hind hoofs in the middle. Mouth of Windy River, August 21, 1947.

FIG. 25. Enormous set of old antlers of a Barren Ground Caribou, with exceptional palmation. (A 10.5-inch length of a steel rule visible.) Simons' Lake, October 15, 1947.

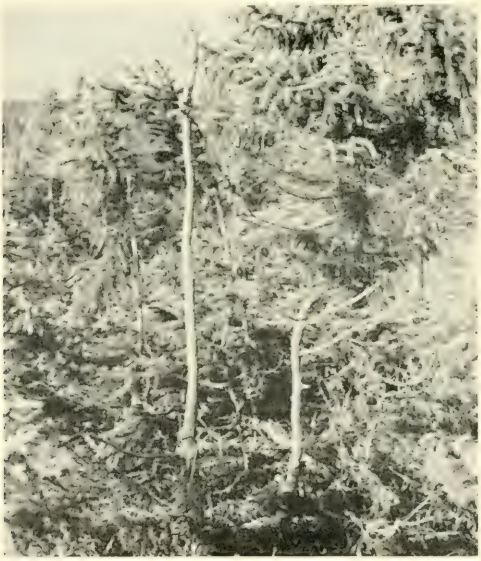

FIG. 26. Rubbing trees: two small black spruces (*Picea mariana*)—the larger 4 feet high—broken and barked by Caribou in rubbing velvet off the antlers. Simons' Lake, October 18, 1947.

FIG. 27. Pile o' Rocks, an ancient enclosure erected as a game lookout on the summit of a hill 1.5 miles NW. of the mouth of Windy River. June 30, 1947.

FIG. 28. Adult male Western Woodland Caribou (*Rangifer caribou sylvestris*) (No. 235361, U. S. Biol. Surveys Coll.). Stony Mountain, about 27 miles S. of Fort McMurray, Alberta, October 22, 1920. (U. S. Fish and Wildlife Service.)

the water. The swimming position tilts the antlers backward until the basal portion is practically horizontal (figs. 9, 12). All ages and sexes, while swimming, hold the tail nearly erect; but the very tip (perhaps only the tuft of hairs) inclines toward the rear.

On October 30 tracks indicated that half a dozen Caribou had swum across Little River near its mouth, breaking through a 10-foot rim of ice on the near side. When a herd of 2,000 or 3,000 crossed Windy River during an October night about 1944, as reported by Charles Schweder, they broke three channels through the thin ice that covered the river.

Once Charles saw a buck cross the 100-yard-wide Nahiline Rapids on Kasmere River, where it drops about 40 feet in a quarter of a mile; yet the animal did not seem to be carried far downstream. When about 10 Caribou (mostly big bucks) crossed the Windy River at our camp on June 24, the last two, I noted, were pointing almost upstream in the 6- to 8-mile-per-hour current.

The usual formation in which a small number of Caribou cross a bay or a quiet stretch of river is a single file, but a larger band is likely to make the passage in several simultaneous files. The fawns, in particular, follow as closely as possible behind their mothers.

Although the Caribou are strong and speedy swimmers, the natives are able, in canoe or kayak, to overtake and spear them. In 1947 several fawns were speared in Windy Bay by Anoteelik.

Other notes on swimming may be found in the sections dealing with *Migrations.*

References.—Back, 1836: 367; Simpson, 1843: 76, 310; Rae, 1850: 27; Richardson, 1852: 290; Schwatka, 1885: 68, 71-72; W. J. McLean, 1901: 6; R. M. Anderson, 1913*b*: 503; Blanchet, 1925: 34; Birket-Smith, 1929 (1): 109-110; Seton, 1929, **3**: 107; Hoare, 1930: 27, 31; Jacobi, 1931: 216; Clarke, 1940: 88-90; Downes, 1943: 256; Harper, 1949: 227, 229, 230; Banfield, 1951*a*: 21.

Shaking off moisture and insects

The long, dense fur of the Caribou holds so much moisture that when the animal emerges from swimming it endeavors to rid itself of the extra burden and cooling agency. This is effected to a large extent by a vigorous shaking of the body, head, and ears and a switching of the tail. The initial performance, lasting for perhaps a second or two, may be undertaken while the animal's lower extremities are still in the water; and it is likely to be repeated from one to several times as it moves over the shore and ascends the adjacent ridge. The cloud of spray flying off is a sight to behold (fig. 9). The action is very much like that of a dog under similar circum-

stances. The fur may remain wet for a least 10 or 15 minutes after emergence from the water. In driving rain on September 5, I noticed an individual in a band of 20 Caribou shaking itself and sending the rain drops flying off in spray, just as when one emerges from the water.

The Caribou also go through a very similar but perhaps still more strenuous performance for the obvious purpose of shaking off flies (perhaps primarily the warble flies, *Oedemagena*). On August 20 a buck passing along a ridge in the Barrens agitated the hide on its body several times with considerable vigor. A young animal (fawn or yearling) thus shook itself on August 28 as it approached the far side of Little River. I got the distinct impression that the hide was shaken horizontally in the case of moisture, but vertically in the case of insects; for the present, however, this is best considered as just an impression, and not a statement of fact. The muscles that agitate the skin of the sides should be particularly well developed through frequent practice with water and flies during the warmer part of the year.

At the mouth of Little River, on August 30, I heard one of the Caribou in a large band "blow its nose," so to speak, with vigor. The sound suggested that produced by a horse in vibrating its nostrils by forcefully expelling air through them. I suspect that the Caribou uses the same means, in an effort to fend off a nostril fly (*Cephenemyia*) bent on depositing its larvae.

Reference.—Harper, 1949: 230.

Signaling

Apparently the commonest method employed by the Caribou for indicating or communicating suspicion or alarm is erecting the stub of a tail to a vertical position. This brings its white under side into full view, as the silent flashing of a danger signal to other Caribou. However, a solitary animal will exhibit signaling behavior as well as one in a band. The tail remains erect, whether the animal stands to stare uneasily at a suspicious object or flees from it in alarm. The action is common to old and young of both sexes. It is so characteristic of a fleeing animal as to give significance to the expression, "high-tailing it." In normal, unalarmed progress the tail extends backward in a drooping curve (figs. 11, 12).

I was not fortunate enough to detect any flashing of the white throat, as described by Preble (1902: 42).

Another silent signal is a most peculiar sprawling posture of

the hind legs, attained by thrusting one of them well out to one side and setting the foot down. The legs are not then symmetrically placed; the one not moved obviously bears most of the weight of the hind quarters. I managed to film this stance in a buck standing on a sky-line on August 24 (cover). On September 9 another buck assumed the posture while looking over our camp from a ridge on the opposite side of Windy River. According to Charles Schweder, this is an expression of suspicion or alarm, designed to communicate the same feeling to other Caribou. When the others notice it, they stop and assume the same pose; it may be observed in does and even fawns. Charles added that the tail is erected at the same time —a very natural accompaniment, though I failed to notice it.

In all the literature on the Barren Ground Caribou, I have found just one reference to this posture, and that a distinctly fragmentary one:

"While [the Caribou are] thus circling around I have often been amused at the manner in which they carry one hind leg. A novice in the hunting field, after having fired a shot in their direction, would think that he had broken one hind leg of each member of the herd." (A. J. Stone, 1900: 53.)

The author makes this observation just after mentioning a herd sighted near the shore of Franklin Bay. A virtually identical posture in the Norway Reindeer has been sketched by Seton (1929, **3**: 112, pl. 18), who labels it "surprize." An analogy to the posture of the Caribou might be found in a hand thrust out, with fingers spread, by a military scout as a signal of warning or caution to his fellow scouts. A sprawling leg is perhaps the nearest approximation to the human signal that a Caribou can attain.

As noted in the section on *Gaits*, an alarmed Caribou may set off by taking an initial leap into the air. According to Dugmore, such an act on the part of the Newfoundland Caribou plays an important role in its system of communications, not by means of sight or sound, but through the olfactory sense. He observes (1913: 89-90):

"For hours afterwards *every* Caribou, on arriving at the place where the frightened ones had jumped, has started violently, and has on nearly every occasion turned and run in a manner that showed every indication of fear, even though my presence was entirely unknown to them. My idea is that when the animal is suddenly frightened it expels a certain fluid from the glands in the foot, and that

this fluid is a signal of alarm, a silent and invisible warning, but none the less so positive that none dare ignore it."

As for the foot click—a presumptive means of communication (*cf.* Seton, 1929, **3**: 69; Jacobi, 1931: 212-216)—I must confess that I was always so engrossed with photography whenever the Caribou were close at hand (up to within a dozen feet) that I had no thought of this phenomenon and did not detect it.

References.—Richardson, 1829: 242; A. J. Stone, 1900: 53; Preble, 1902: 42; Seton, 1929, **3**: 105; Murie, 1939: 245; Harper, 1949: 230; Banfield, 1951*a*: 19, 27.

Food

The ground lichens (including the various species of *Cladonia*) in the Windy River area in 1947 did not seem, for the most part, to have a height of more than 2 or 3 inches. The average length of several local specimens of *Cladonia* is approximately 51 mm. This condition was in considerable contrast to the great spongy masses I had noted in the Tazin River basin, between Athabaska and Great Slave lakes, in 1914. I have no means of knowing whether the condition in Keewatin represented severe cropping by Caribou in past years and subsequent slow recovery, or whether it is a normal condition. According to Charles Schweder, the growth depends upon rain, and so varies from year to year. During the warmer months, from June to September, the local Caribou seemed to me to be feeding very largely on the higher vegetation, such as willow, dwarf birch, alder, and sedges. I had no definite evidence of their consuming lichens during that period. By early October the species of *Cladonia* seemed to have attained a somewhat fuller growth than they had exhibited several months previously. Perez-Llano discusses (1944: 29-30) the utilization by Reindeer of various lichens. Dix has reported (1951) on a collection of lichens from the Windy River area.

Some miscellaneous observations along Windy and Little rivers follow: June 16, 20 Caribou feeding apparently on patches of crowberry (*Empetrum*) and dwarf birch (*Betula glandulosa*) on a ridge; June 29, a Caribou feeding apparently on dwarf birches; June 30, a buck grazing in a sedge bog; August 26, several bucks browsing on willow tops (probably *Salix planifolia*) in a riverside thicket, and some does on dwarf birch and perhaps tall grass or low willow; August 27, numbers feeding largely on willow and dwarf birch; August 28 and 30, low alders, willow, and dwarf birches nibbled off. By early October the leaves of the three last-mentioned

shrubs were no longer available, having dropped off. During the summer they had seemed to be preferred above the lichens. Cabot has remarked (1912: 46) on the fondness of *Rangifer arcticus caboti* for dwarf birch in Labrador.

Charles Schweder reported as follows on the food of Caribou. In summer they live chiefly upon leaves, especially those of dwarf birch, and to some extent upon "grass" (probably largely sedges). Toward the last of June a Caribou was killed with fat an inch thick on its haunches—perhaps the effect of recent feeding on the fresh green vegetation. In August and September the animals also eat mushrooms and get very fat on them; they seem to be especially fond of a certain red kind, which Charles has found in their stomachs. The Eskimos' name for mushrooms signifies "deer food." The Caribou feed upon dead "grass" (perhaps mostly sedges) in the fall, but not in the winter. Charles has seen them digging through 4 feet of snow to get at the reindeer lichens; but for the most part their winter feeding in this region is on the tops of the hills, which remain bare. They also eat tree lichens, especially in the winter time.

Charles has seen Caribou chew the cud while standing as well as while lying down. He once saw a buck thus occupied while standing on a hill for half a day in a breeze that kept the mosquitoes down.

Among the hundreds of Caribou observed at the river crossings and elsewhere, I do not recall seeing a single one pause to drink.

The *Influence of food supply on distribution* of the Barren Ground Caribou has been discussed in a previous section.

References.—Hearne, 1795: 317; Franklin, 1823: 242; Richardson, "1825": 329, and 1829: 243; Godman, 1831, **2**: 284; Richardson, in Back, 1836: 498, and 1861: 275; Murray, 1858: 202; B. R. Ross, 1861: 439; Kumlien, 1879: 54; J. B. Tyrrell, 1894: 441; Russell, 1898: 226; J. W. Tyrrell, 1908 (1898): 80; Lydekker, 1898: 49; Elliot, 1902: 276; Stone and Cram, 1904: 53; Buchanan, 1920: 105-106, 131; Hewitt, 1921: 61; Blanchet, 1925: 33; Seton, 1929, **3**: 107-108; Kitto, 1930: 87; Jacobi, 1931: 223; Harper, 1932: 30; Sutton and Hamilton, 1932: 84; Weyer, 1932: 39; Hornby, 1934: 105; Murie, 1939: 245; Clarke, 1940: 106-107; G. M. Allen, 1942: 299; Soper, 1942: 143; Downes, 1943: 228; Porsild, 1943: 383; R. M. Anderson, 1948: 15; Manning, 1948: 26-28; Rand, 1948*a*: 212; Harper, 1949: 230; Banfield, 1951*a*: 11, 19-20, 28-29; Barnett, 1954: 106.

Scatology

The pellets of the Caribou are small, more or less blackish, very irregular in shape, somewhat compressed, and generally deposited in little piles, in which the individual components do not stand out

very distinctly, being pressed against each other. They are quite unlike the oblong, curvilinear, comparatively symmetrical scats of the White-tailed Deer and the Moose. I did not observe, nor learn of, any particular seasonal variation in the shape or other characters.

References.—Sutton and Hamilton, 1932: 81; Manning, 1943*a*: 50.

Voice

My impression of the adult Caribou is that it is a comparatively silent animal during most of the year. At the rutting season, however, when the bucks do their fighting with a clash of antlers, their voice is heard, as Fred Schweder, Jr., informed me. It is about as loud as the fawn's grunt, but a different sort of sound. Fred has also known a doe to call when its fawn was shot.

The only vocal sound that I heard from the Caribou was the grunt or bawling of the fawns on the fall migration, and only during the last week of August, when the "big movement" was under way. It was uttered chiefly at the river crossings, apparently as a result of the fawns' anxiety lest they be separated from their mothers during the slight uncertainty or confusion of these passages, when a considerable number of animals were participating. It seemed to be a fair equivalent of a human child's crying out: "Don't leave me behind!" or "Where are you, mamma?" The grunt is very different from the bleating of a lamb or the bawling of a domestic calf. It is a surprisingly raucous or guttural, almost explosive, yet not very loud note, which I rendered at various times as *gwuf, goff, gowk,* or *gorr.* Perhaps the last rendering comes nearest to the actual sound. With one or two exceptions, I did not identify any individual uttering one of these grunts; but the Schweder boys, from their intimate knowledge of the species, assured me that this was the voice of the fawn. In one case the sound came rather definitely from a fawn that had become somewhat separated from its band in going up the adjacent ridge after crossing Little River. But for the most part the grunts seemed to come from swimming animals.

On August 30 another sort of sound—probably not a vocal one —seemed to come from one of the older animals among a large band crossing Little River. It was probably produced by a vigorous vibration of the nostrils. It is further discussed in the section on *Shaking off moisture and insects.*

It is rather astonishing that Seton, after seeing and studying many Caribou at close range in Mackenzie, should say no more

about their voice than: "They snort a good deal and grunt a little" (1911: 210). In his later monographic account he practically ignores the topic, merely referring to the animals' "sniffing, snorting" (1929, **3**: 105).

References.—Lyon, 1824: 336; Pike, 1917 (1892): 89; Stone and Cram, 1904: 53; Seton, 1911: 210, and 1929, **3**: 105; Hornaday, 1914, **2**: 103; Critchell-Bullock, 1930: 193; Sutton and Hamilton, 1932: 84; Murie, 1939: 245; Downes, 1943: 226, 256-257; Harper, 1949: 230; Banfield, 1951*a*: 22.

Reproduction

By the time the rutting season arrived in mid-October, there were comparatively few Caribou left in the Windy River area. Consequently my information on the subject was derived mainly from Charles Schweder and Fred Schweder, Jr. Weeks before the scheduled season, there were certain manifestations of the sexual urge. For example, on September 5 about 20 Caribou were passing the Bear Slough. The band consisted mostly of does and fawns, but included several middle-aged bucks (with antlers much less than the maximum size) and possibly some younger bucks. Twice I saw one of the animals attempt to cover another, but driving rain and the compactness of the band prevented me from determining the sex or age of those involved. During a trip to the Kazan River, lasting from September 17 to October 1, Fred observed a good deal of fighting among the Caribou—obviously a prelude to the mating season. In Charles' opinion, these early contests are not very much in earnest; the real fighting begins about October 15. On October 8 Charles and Fred referred to fighting that was going on among a herd of about 100 between Glacier Pond and Lake Charles. Perhaps less than a quarter of this herd were older bucks; the rest, younger bucks, does, and fawns.

In former years, while living at the "Old Post" on Red River, Charles used to go out and watch the fighting on a big open muskeg, about a mile square, where the Caribou would congregate practically every year at the rutting season, up to a thousand strong. They would stay for three or four days, then disappear. Nothing on the same scale had come to his notice in the vicinity of the Windy River post. At this season, when the animals are in large herds, the bucks utter their calls, as mentioned in the section on *Voice*. According to Fred, one sees in October a good many bucks with an antler broken off in the fighting. The break generally occurs at about the middle of the antler. On September 29 Charles reported a buck with a broken antler, which he interpreted as evi-

dence of the beginning of the fighting season. During the rutting season he once shot a buck with a broken jaw, and another with an eye gone. The possible inference was that these injuries had been sustained in fighting. A buck secured on October 16 had apparently been wounded in fighting; there was pus in its neck, and it was considered unfit for eating. I heard nothing as to the possible use of hoofs in contests between bucks, as reported by Jacobi (1931: 233) for the Reindeer.

During the rutting season the herd is likely to be a large one, and to do little traveling. It is composed of fawns as well as adults. The bucks pursue the does, and sometimes chase each other. Charles thinks the young bucks keep away from the does at this time, being unable to fight the older bucks with larger antlers. Fred reports a proportion of about 10 bucks to 50 does in these herds—a probable indication of polygamy. He expressed the opinion that the bucks do not mate until 8-10 years old, and the does not until about four years old. However, he was basing his estimate of the age on the total number of points on the antlers—one point for each year; and on this basis the age was probably much overestimated. Earlier sexual maturity on the part of the doe might be another indication of polygamy in the species.

At the onset of this season, the bucks neglect their feeding to some extent; consequently those killed have stomachs only partly filled, instead of completely filled, as at other times. By mid-October their fat becomes tinted with reddish, and the whole flesh becomes so rank and musky that it is disdained not only by human beings but even by the Wolves. This condition seems to be considerably more pronounced in the Caribou than in the White-tailed Deer. The hunters forego eating the old bucks for a period of several weeks. Meanwhile the younger bucks, not engaged in mating, remain fit to eat. Hearne (1795: 69) reported the flesh of bucks as still unpalatable as late as December 30.

The rutting season is said to continue through October into November. The end of the period is uncertain, but it may coincide with the shedding of the antlers of the old bucks.

References.—Hearne, 1795: 72, 198-199; Richardson, "1825": 327-328, 1829: 243, and 1861: 274; Pike, 1917 (1892): 48, 90; J. W. Tyrrell, 1908 (1898): 80; Hanbury, 1904: 73; Stone and Cram, 1904: 52; Blanchet, 1925: 33; Birket-Smith, 1929 (1): 51, 56; Seton, 1929, **3**: 124-125; Jacobi, 1931: 232; Sutton and Hamilton, 1932: 81, 84-86; Weyer, 1932: 40; Ingstad, 1933: 158; Hornby, 1934: 105; Murie, 1939: 244; Manning, 1943*a*: 52; Banfield, 1951*a*: 10, 26, 31.

Fawns

Since the fawning takes place far to the north of the Nueltin Lake region, practically no local information concerning it was obtained. Charles Schweder stated that in the spring migration the pregnant does pass to an undetermined distance north of the upper Kazan River (below Ennadai Lake). Although the migration at Nueltin Lake continues throughout June, the rearguard is composed largely of bucks, and the comparatively few does accompanying them toward the last may be barren. Fisher (1821: 199) and Parry (1821: 183) report a small fawn of *R. pearyi* on Melville Island on June 2. Richardson states ("1825": 329) that the young are born in May and June. There is evidently some geographical and individual variation in the time of birth (*cf.* Jacobi, 1931: 232). Apparently the gestation period in the Caribou covers approximately eight months or a little less. In the domesticated Reindeer it is 231 to 242 days, according to Jacobi (1931: 234); in the White-tailed Deer, 205 to 212 days, according to Seton (1929, **3**: 258).

Fred Schweder, Jr., stated that he had never found more than a single unborn fawn in any one of the animals he had secured; yet he has seen as many as four fawns following a doe. Of course there is no proof that this individual was the actual mother of so many fawns; a stray or bereaved youngster might well endeavor to attach itself to a foster mother. On August 28, at Little River, I saw a doe being followed by two fawns. On September 16 Fred reported seeing three old does without fawns. Presumably most of the does do not bear young until they are two years old (*cf.* Jacobi, 1931: 235); thus many yearling does without family cares should be observed during the summer.

On September 12 Charles Schweder stated that the does would soon be losing their milk; yet on occasion he has found them with milk as late as November (*cf.* Jacobi, 1931: 235). On September 21, when he secured a doe (fig. 21) that was accompanied by a fawn, I asked if he thought the latter was still nursing. By way of answer, he squeezed a couple of the doe's mammae, and some milk exuded. Thus the mammary glands were still functioning at that date; they appeared well developed. By August 27, at an age of perhaps two and a half months, the fawns were browsing on their own account, and their teeth were well developed. Fred Schweder, Jr., then spoke of having seen fawns nursing four times during that month, the last occasion having been on the 25th. On the 27th I had the rare privilege of witnessing such a nursery rite across the mouth of

Little River. The wilderness baby was so large that it was obliged to lower its forequarters very decidedly in order to reach the maternal font (from a lateral position). This attitude left its hind quarters thrust high and ludicrously into the air. I did not notice that it wriggled its tail as a bovine calf might have; but Charles Schweder spoke of having seen a fawn hold its tail erect while nursing. He also said that the bigger fawns kneel down with their front legs while so engaged. In his opinion, when a doe is killed in the autumn, its fawn does not go and join other Caribou, but lingers near the fatal spot until a Wolf or some other enemy overcomes it. For this reason it is his practice to secure the fawn also, if possible, when he takes the mother. On September 13 a fawn remained by its dead mother, permitting one of the hunters to approach within 30 feet and to throw rocks at it three times, finally taking it by that means. After a doe was killed on September 21, its fawn lingered in the vicinity for a day or two.

References.—Franklin, 1823: 242; Richardson, "1825": 329; John Ross, 1835*a*: 432; Simpson, 1843: 277, 281, 381; J. McLean, 1932 (1849): 359; Armstrong, 1857: 477-478; Murray, 1858: 202; Osborn, 1865: 227; Nourse, 1884: 264-265; Pike, 1917 (1892): 204, 209; Dowling, 1893: 107: Russell, 1895: 51; R. M. Anderson, 1913*b*: 504-505; Hewitt, 1921: 62; Blanchet, 1926*b*: 47; Seton, 1929, **3**: 124-125; Blanchet, 1930: 49, 53; Critchell-Bullock, 1930: 192, 193; Sutton and Hamilton, 1932: 86; Ingstad, 1933: 161; Clarke, 1940: 88-90; Gavin, 1945: 228; Banfield, 1951*a*: 26, 27; Scott, 1951: 179, 180; Barnett, 1954: 96.

Growth

During late August and early September the fawns probably averaged about 50 lb. in weight. (For the measurements of two specimens, see the section on *Measurements.*) Yet they varied so much in size that some appeared nearly twice as big as others. On September 7 an exceptionally small fawn was secured (estimated weight, 35 lb.) (fig. 23). Its coat was soft and woolly, representing an earlier stage than that seen in any of the other fawns of that season. It was molting into the next pelage, and its hide was unprime. It must have been born at an unusually late date. Fred Schweder, Jr., remarked that he sometimes sees this stage in the growth of fawns when the Caribou come down early from the north (about the first of August), but it seems remarkable that it should have been found in a September fawn. The present specimen has actually smaller measurements than one secured on August 2 at Artillery Lake (Seton, 1929, **3**: 97). The collector reported that the parent doe appeared of ordinary size—not a particularly small or young one. The yearlings noted on the spring migration

in May (south of Churchill) and in June (at Nueltin Lake) appeared roughly half the size of the adults.

Evidently several years are required for the attainment of full growth. The younger adult bucks, with smaller antlers, are appreciably inferior in body size to the older bucks, with better developed antlers.

References.—Seton, 1929, 3: 97, 98; Banfield, 1951*a*: 30.

Antlers

In late August and early September antlers were already in evidence on the fawns, at an age of less than three months. They consisted of bony knobs, covered with skin, and were an inch or two long. I obtained no information as to when the fawns may shed the velvet or the antlers themselves. By analogy with the Reindeer (*cf.* Jacobi, 1931: 237), the fawns might be expected to drop their antlers in late winter.

When the adult Caribou return from the north in August, the antlers of all are still in the velvet. However, completely hornless does are not particularly uncommon at this season; in Charles Schweder's opinion, some remain permanently in that condition. Hornless does are reported in various forms of Caribou or Reindeer in both hemispheres (Jacobi, 1931: 48). I saw also a few one-horned does on the autumn migration. In a single group of three adult does photographed at close range on August 28, one was hornless and another one-horned (fig. 11). A considerable proportion of my other photographs of Caribou groups at this season show one or more animals with a single antler or none. The hornless condition appears to be astonishingly more common in Keewatin than in regions farther west. Stefánsson, whose field operations were chiefly in northern Mackenzie and southwestern Franklin, remarks (1913*b*: 151) on having found, at any season when Caribou are normally horned, just three hornless animals among a thousand at whose killing he had been present. Murie (1935: 20) speaks of having observed only one hornless doe in Alaska, in September.

By late August the bucks' antlers have attained nearly their full growth, though still in the velvet. The largest head of the season was obtained on August 22. Its measurements were: right antler, in straight line from base to tip of longest prong, 995; left antler, 980; distance between main tips of the two antlers, 620; brow tine, from base to upper tip, 335; to lower tip, 290. For the older bucks, the principal period for shedding the velvet is September 10 to 20, although Charles Schweder once observed a buck that had

completed the process by September 1, and Fred secured one in that condition on September 6, 1947. In Alaska old bucks shed the velvet more or less regularly in September (Murie, 1935: 26). Sick or wounded animals are said to retain the velvet for an indefinite period. For example, a buck secured on September 29 had some velvet hanging in shreds from the tips of its antlers, and it was found to have been shot in the mouth sometime previously. The younger bucks and the does lose their velvet somewhat later than the older bucks (say toward the end of September). In a doe of September 21 (fig. 21) the antlers were covered with velvet and still had soft tips. A young buck of October 2 was just shedding the velvet.

Charles Schweder spoke of noting as many as 30-33 points on the antlers of old bucks. (He probably included the brow and the bez tines in this count.) He also referred to an exceptional set of antlers at Simons' Lake with about 40 points; he had first noted it about 10 years previously, and it had doubtless been there for years before that. He had never been able to secure its equal. When I saw and photographed it in October (fig. 25), some of the points were broken off, so that an accurate count was impossible; but there must have been close to 40 originally, even without the brow tines, which were missing. The palmation was much broader than I have seen in any other Caribou.

The prong projecting backward at the angle of the main beam is by no means so uncommon in the animals of this region as a Chipewyan hunter seemed to indicate to Downes (1943: 227-228).

Charles Schweder found a pair of locked antlers about 1940 near Josie's Bay. This was the only case of which he had any knowledge. An instance of locked antlers in *Rangifer pearyi* is mentioned by Peary (1907: 84).

There is marked variation in the dates of shedding the antlers, according to sex, age, and physiological condition of the individual. This has resulted in various conflicting statements in the literature. In the present region, the old bucks with 25 or more points are said to shed their antlers about the end of October or in November, at the close of the rutting season. (Fred Schweder, Jr., encountered a hornless buck as early as November 7, 1947.) The younger bucks, with 15 to 20 points, and the does retain their antlers till late May or June of the following year. A doe of June 3 and another of June 16 were still horned. In Alaska "the young bucks may carry their

old antlers until late in April, while does carry theirs until the middle of May, some of them until June" (Murie, 1935: 26).

John Ingebrigtsen reported having seen two or three shallow lakes, between Churchill and (South?) Knife Lake, whose bottoms were fairly covered with caribou antlers. They were visible through clear ice. It appears probable that these lakes, while ice-covered, were favored resorts of large numbers of Caribou for their midday or nocturnal rests at a period when they were shedding their antlers (November for the old bucks, May or June for the does and young bucks).

It is natural that the season at which the new antlers of the Barren Ground Caribou begin to grow should vary greatly according to sex and age, just as the shedding of the antlers does; probably also, for the various forms of *Rangifer*, according to locality (*cf.* Jacobi, 1931: 237). On Southampton Island "the new antlers begin to appear in the males in March and April" (Sutton and Hamilton, 1932: 85). In Alaska Murie (1935: 24) "has found old bucks late in April with velvet knobs well begun." Seton's account (1929, **3**: 102-103) of the seasonal change of antlers is not only meager but largely at variance with the information I assembled in Keewatin. Recently gathered information is supplied by Banfield (1951*a*: 17-18).

Measurements of the length of antlers in the velvet (right and left, respectively) were recorded as follows: adult male, June 18, 420, 440; adult male (figs. 3, 4), August 17, 1165, 1205; adult female (fig. 21), September 21, 220, 165.

Scratching or anointing of antlers in the velvet with a hind hoof was observed in an adult buck on June 16, and in a fawn on August 27.

While there is undoubtedly some correlation between the age of a Caribou and the number of points on its antlers, I am not aware that such a correlation has been worked out to a satisfactory degree. The Schweder brothers judged a Caribou's years by the number of points on both antlers, yet freely admitted that they had limited confidence in such a criterion. Probably they would be nearer the actual facts if they counted the points on only one antler. The situation is complicated by the fact (if we are to credit Jacobi, 1931: 238) that bucks in other forms of *Rangifer* exhibit the best development of antlers at six to eight years.

References.—Hearne, 1795: 198-199; Franklin, 1823: 240-241; Lyon, 1824: 270; Richardson, "1825": 327-328, and 1829: 241; Richardson, in Back, 1836: 499; Armstrong, 1857: 478; Murray, 1858: 199-206; B. R. Ross, 1861: 439; Osborn, 1865: 227; Pike, 1917 (1892): 49; J. B. Tyrrell,

1892:128; Dowling, 1893: 107; Russell, 1895: 51, and 1898: 225; Whitney, 1896: 238-239; J. W. Tyrrell, 1908 (1898): 79-80; A. J. Stone, 1900: 53; W. J. McLean, 1901: 6; Elliot, 1902: 279-280; Hanbury, 1904: 95, 116, 133; Hornaday, 1904: 138; J. A. Allen, 1908*a*: 488; R. M. Anderson, 1913*b*: 505; Stefánsson, 1913*b*: 151; Buchanan, 1920: 126; Blanchet, 1925: 33, 1926*b*: 47-48, and 1930: 49; Birket-Smith, 1929 (1): 50, 89, 239-251; Seton, 1929, 3: 102-103; Critchell-Bullock, 1930: 192; Jacobi, 1931: 237; Sutton and Hamilton, 1932: 81-86; Ingstad, 1933: 159; Hornby, 1934: 105; Murie, 1935: 20, and 1939: 244; Clarke, 1940: 95; Downes, 1943: 228; Manning, 1943*a*: 52-53; Harper, 1949: 228; Banfield, 1951*a*: 17-18; Barnett, 1954: 104.

Rubbing trees

Charles Schweder gave the following account. The bucks hasten the shedding of the velvet in the autumn by rubbing their antlers on various trees—willow, spruce, or tamarack. The individual may complete the operation in possibly half a day. It is thought, however, that most of the velvet comes off at the first tree. The animals usually select a tree standing by itself rather than one in a thicket. It is usually a small tree—say 4 feet high and 1 inch in diameter. Perhaps a spruce is most often selected. Branches are broken and much of the bark is scraped off in the process. The velvet soon dries up, so that it is little noticed. Charles did not recall having seen any hanging in a tree.

The numbers of rubbing trees that I noticed at Simons' Lake in mid-October indicated that Caribou must have been much more numerous there during the previous month than in the vicinity of the Windy River post. These trees were particularly in evidence on the outskirits of a spruce and tamarack thicket at the head of the lake. They were mostly tamaracks, with some black spruces. Of the two spruces shown in figure 26, the larger was about 4 feet high. Many of the young trees had been killed. The branches and the tops had been pretty generally broken off and were lying on the ground. Most of the damage was fresh, but some of it dated from previous years.

Reference.—Hanbury, 1904: 232.

Morphology and Taxonomy

Pelage and molt

When the Caribou migrate northward through the Nueltin Lake region in May and June, they still retain their winter pelage. It is now worn and faded, and harsh as well, in contrast to the fresh, dark, soft autumn coat.

This stage is represented by an adult buck (No. 1046) of June 18. The general color above is Cream-Buff (capitalized color terms

are derived from Ridgway, 1912), changing gradually to Isabella Color on sides of head and body; no distinct dark longitudinal stripe on lower sides (such as appears in summer and autumn pelage); tail Cream-Buff above, the rest Cartridge Buff; rump-patch varying from Cartridge Buff to Cream-Buff; tip of snout and chin dirty whitish; small area below nostrils near Mummy Brown; triangular area behind nostrils Cream-Buff; crown Cartridge Buff; ears Olive-Buff on outer surface, Cartridge Buff on inner surface; posterior venter Cartridge Buff; legs Isabella Color in front, remainder Cream-Buff; hoofs black, bordered above with Cartridge Buff hairs, forming a band ½-2 inches in width; antler velvet in this and other specimens Olive-Brown. The marked difference between the dark brownish and white pelage of the autumn and the Cream-Buff coat of early June presumably results from wear and fading, without molt. The does and the yearlings in June appear grayer than the adult bucks.

In another adult male (No. 1033), collected June 3, the darker part of the pelage is Buffy Brown rather than Cream-Buff.

The molt of the bucks begins in June but takes place chiefly in July, while the animals are somewhere to the north of the Nueltin Lake region. On their return in August they have largely completed their summer transformation in appearance. A buck of August 17 had just a little of the winter fur still clinging to its lower back; and another on August 20 was in similar condition. At this season the white mane is developed only on its lower portion (figs. 9, 10, 12), but by the end of September the white has spread upward over practically the whole neck (fig. 22), and in some cases over the shoulders.

In an adult male (No. 1144) of October 16, representing the pelage of the rutting season, the posterior crown is near Tilleul Buff, the anterior crown somewhat browner; sides of head and upper throat between Verona Brown and Buffy Brown; area about and between eyes somewhat darker; triangular area behind nostrils (apex extending halfway to eyes) and lower chin between Mummy Brown and Warm Blackish Brown; tip of snout and chin Cartridge Buff; ears pale creamy white on both surfaces; whole neck and shoulder mantle whitish, washed with Cartridge Buff, and changing gradually to the brownish of the sides of the head; long hairs along median ventral line of the neck tipped with Natal Brown; dorsal area, from shoulders to rump, Prout's Brown; stripe on lower sides Mummy Brown, separated from dorsal area by an ill-defined lighter

stripe, mixed with whitish hairs; top of tail slightly paler than back, the rest white; small rump-patch mostly white; chest Mummy Brown; mid-venter varying from Deep Olive-Buff anteriorly to Cream-Buff posteriorly; posterior venter white; forelegs near Bone Brown; hind legs between Mummy Brown and Olive-Brown, with a pale spot on the inner side of the heel (this spot noticeable also in doe and fawn); hoofs black, bordered above with whitish hairs. The hides of this specimen and of two other adult bucks (No. 1111, September 29, and No. 1132, October 16) were prime. The dark lateral stripe, which shows quite distinctly in summer and fall specimens of both sexes (figs. 7, 8, 10, 21, 22), from fawns (except very young ones) to adults, and which is also a prominent feature in Old World Reindeer (*cf.* Flerov. 1933), has been largely or wholly overlooked in some descriptions of *Rangifer a. arcticus.*

The summer molt occurs later in the does than in the bucks. Some of the former return toward the end of August while still retaining most of the winter pelage. Others exhibit remnants of it in patches, especially on the lower back; this was true even of an adult doe (No. 1101) secured as late as September 21 (fig. 21). Its hide, however, was prime. In this specimen the crown is near Verona Brown, with varying admixture of whitish hairs; sides of head Verona Brown; upper throat a little paler; a poorly defined area behind nostrils, and lower chin, Mummy Brown; tip of snout and chin Cartridge Buff; ears Drab, varying to Pale Olive-Buff, especially on inner surface; neck Drab dorsally, mixed with whitish hairs, the remainder Pale Olive-Buff; dorsal area, from shoulder to rump, Mars Brown; lateral stripe on lower sides Mars Brown, separated from dorsal area by a poorly defined but conspicuous area of Light Cinnamon-Drab; top of tail like back, the rest whitish, washed laterally with Pale Pinkish Buff; small rump-patch mostly white; chest Mummy Brown; venter Light Drab, becoming whitish in inguinal region; forelegs Natal Brown, slightly darker in front; hind legs Natal Brown, with a pale spot on the inner edge of the heel; hoofs black, bordered above with whitish "spats" varying from ½ to 1½ inches in width.

Another doe, secured on November 3 but not preserved, was apparently in long, full winter pelage, with whitish mane and shoulders. The dorsum generally was grayish; the top of the rump, buffy gray. The white rump-patch appeared to be more extensive, and to contain longer hairs, than in the doe of September 21; likewise the white "spats" appeared much more extensive.

As winter comes on, the fur of the Caribou grows longer and paler gray. One incipient stage of such a change from the summer coat began to be noticeable as early as September 13. A buck that came trotting down out of the Windy Hills on September 27 revealed the splendor of its new winter coat, with an amazing amount of creamy white, chiefly on the mane and shoulders. The long mane wears off during the winter, according to Charles Schweder. It looks best, he added, when the bucks start to fight in the fall. A yearling or large fawn on October 21 was distinctly creamy about the neck and shoulders. After describing a winter female from Wager River, Seton remarks (1929, **3**: 98): "The general impression is of a creamy white animal, with a gray blanket on its back."

For the first couple of months of its life the fawn wears a soft and woolly coat. An example was furnished by a male fawn (No. 1095; fig. 23) of September 7, which must have been born several weeks later than the average date. It was actually smaller and less developed than another male fawn collected on August 20. It was molting into the next pelage (described in the following paragraph), and its hide was unprime. The general color is Deep Brownish Drab; this is overlaid with longer hairs of Pale Olive-Buff on the median dorsal line of the neck, on the venter, and on part of the legs; a median stripe on the back near Hay's Brown; no distinct lateral stripe; ears and posterior crown Cartridge Buff; forepart of crown Deep Brownish Drab; area above eye Cream-Buff; snout varying from Deep Brownish Drab above to Pale Gull Gray on sides; transverse band behind nostrils Dusky Brown; tip of snout whitish; tail Deep Brownish Drab above, pale creamy on sides, and white beneath; rump-patch whitish; chin anteriorly whitish, posteriorly Dusky Drab; throat whitish to Pale Gull Gray; lower part of legs, in front, Buffy Brown; hoofs black, bordered above with a very narrow (¼-inch) strip of whitish hairs. A very similar young fawn, taken on August 2, 1907, has been described by Seton (1929, **3**: 98).

In a male fawn (No. 1072) collected on August 20 the general color is between Olive-Brown and Natal Brown; a paler longitudinal area separating the lateral stripe from the dorsal area; ears Clove Brown externally, pale creamy internally; transverse band behind nostrils Blackish Brown; tip of snout whitish; sides of head varying from Cream-Buff above eyes to Cartridge Buff below; tail Bone Brown above, white below; rump-patch whitish; legs Buffy Brown, darker in front; chin anteriorly whitish, posteriorly Hair Brown;

throat Cartridge Buff; venter Light Drab; hoofs black, bordered above with a narrow (¼- to ½-inch) strip of whitish hairs.

References.—Franklin, 1823: 240-241; Richardson, 1829: 242; B. R. Ross, 1861: 439; Schwatka, 1885: 60-61; J. B. Tyrrell, 1892: 128; Russell, 1898: 91, 226; J. W. Tyrrell, 1908 (1898): 79; A. J. Stone, 1900: 52; Hanbury, 1904: 194; MacFarlane, 1905: 682-683; Blanchet, 1925: 33, and 1926*b*: 47; Seton, 1929, **3**: 98-99, 104; Critchell-Bullock, 1930: 193; Jacobi, 1931: 236; Sutton and Hamilton, 1932: 81, 84-86; Murie, 1939: 244; Clarke, 1940: 89, 90; Downes, 1943: 226; Manning, 1943*a*: 53; Harper, 1949: 228, 229, 230; Banfield, 1951*a*: 15-17.

Albinism

In *Rangifer arcticus arcticus* this appears to be an exceptionally rare phenomenon. There are references to albinos by the following authors: Russell (1895: 51; 1898: 91, 226), Whitney (1896: 237), Boas (1901: 150, 501), MacFarlane (1905: 682-683), Ingstad (1933: 312), and Degerbøl (1935: 49, 51).

Foot-glands

I dissected out the glands from the hind feet of an adult male Caribou (No. 1046). Seton (1929, **3**: 68) has discussed these structures in the Woodland Caribou and the Norwegian Reindeer; and Pocock (1911: 960-962, fig. 138B) and Jacobi (1931: 22, fig. 4), in the Reindeer. Many hairs had their base in the glands, and there was a fatty secretion on the hairs adjacent to the glands. I judged that the opening to the exterior extended in a more or less dorso-anterior direction. One of the suggested functions of these glands is anointing the velvet covering of the antlers. I was highly interested, therefore, in seeing an old buck on June 16 rub the tips of its growing antlers with each hind foot in turn. Meanwhile it inclined its antlers alternately to one side and backwards to place one of them at a time within convenient reach of the hind foot on that side. It seemed to rub its snout as well as the antler tips. In Charles Schweder's experience this action was always carried out with the hind foot, not the forefoot. The latter contains a similar but smaller gland, according to Jacobi (1931: 22), while Pocock (1911: 960-961) gives contrary testimony. On August 27 I also saw a fawn rubbing a knob of its skin-covered antlers with a hind foot.

Another function of the foot-glands is suggested by an observation of Dugmore's (1913: 89-90), which has been mentioned in the section on *Signaling*. I could not definitely connect any of the various occasions of panic that I observed, with scent from the foot-glands of preceding Caribou that had been frightened.

References.—Caton, 1881: 265; Pocock, 1911: 960-962; Seton, 1929, **3**: 68, 105; Sutton and Hamilton, 1932: 84; Harper, 1949: 230.

Mastology

Very little seems to have been published on this subject. Jacobi (1931: 24) merely remarks that in the Reindeer the mammae number four, or occasionally six, but that the supernumerary ones are not functional. The four rudimentary mammae in a male fawn of *arcticus* (No. 1072) of August 20 seemed remarkable for their arrangement in a nearly straight transverse row—quite different from the more rectangular pattern in a domestic Cow or in a male Moose, as figured by Seton (1929, **3**: 221). In an adult doe (No. 1101) of September 21 the anterior pair are about twice as far apart as the posterior pair; each of the mammae appears no more than a couple of inches from the one nearest to it. The arrangement in a two-year-old buck, as shown by Seton (1929, **3**: 106), is approximately intermediate between linear and rectangular.

Fat

A Caribou (probably a buck) secured about the end of June was reported to have back fat half an inch thick—possibly resulting from the fresh green spring feed. In August, however, scarcely any fat was to be found on the animals; perhaps the annual renewal of pelage and the summer harassment by flies had been deterrents to the storage of fat. In September and early October the Caribou were in prime condition. On September 19 there was a fresh piece of back fat half an inch thick; two days later there was another piece three times as thick. In 1943 (a year of great mushroom growth) the animals were said to have become particularly fat. According to Charles Schweder, the doe never becomes so fat as the buck; one of September 21, still nursing, was just slightly fat. An adult buck of September 29 was recorded as "somewhat fat"; two of October 16 were "rather fat" and "quite fat." Charles has seen as much as 3 inches of fat on a buck. The strips of back fat brought into camp on October 8 from several bucks weighed about 5 to 10 lb. apiece. Such fatness evidently prepares the bucks for the strain of the rutting season, when they neglect their feeding and become very poor and thin. This loss of fat occurs in about two weeks. The does also lose some fat at this season, but slowly. In some winters the Caribou remain fat, but in other winters they do not. In the latter case there may be deep snow that hinders their feeding. In the spring the Caribou become fat again, and they are in that condition when they arrive from the south in May.

The eagerness of the Eskimos and the Indians for fat results in their selection of the biggest bucks, which generally carry the most fat. Charles Schweder spoke of the tail of such an animal almost disappearing, apparently engulfed in fat! Besides its use in the native diet, the fat goes into the making of "Eskimo candles" (see section on *Relations to man*).

References.—Franklin, 1823: 240; Armstrong, 1857: 477-478; Whitney, 1896: 161; Elliot, 1902: 276; R. M. Anderson, in Stefánsson, 1913*b*: 505-506; Stefánsson, 1921: 231-234, 246-247, 252; Jenness, 1922: 48, 101, 248; Birket-Smith, 1929 (1): 48, 90; Seton, 1929, **3**: 113-114; Critchell-Bullock, 1930: 193; Weyer, 1932: 40; Hornby, 1934: 105; Hamilton, 1939: 109; Downes, 1943: 228; Manning, 1943*a*: 53.

BODY-MEASUREMENTS AND WEIGHTS

No.	Sex and age	Date	Length	Tail	Foot	Ear from crown	Height at shoulder	Shoulder joint to hip joint	Circumference of neck at base	Circumference of body behind shoulders	Length of front hoof	Length of hind hoof	Estimated weight (lbs.)
1033	♂ ad	Jun 3	1820	160	516	130		1000		1000	81.5	78	140
1046	♂ ad	Jun 18	1880	190	546	137	1029				92	84.5	
1065	♂ ad	Aug 17	1750	146	555	120	1080	1010		1185*	80	74	200
1111	♂ ad	Sep 29	1710	155	532	129	1020		740		82.5	78	200
1132	♂ ad	Oct 16	1710	120	530	120	1002	975					200
1144	♂ ad	Oct 16		117	545	120	1110				90	84.5	200
Average of	♂♂ ad		1774	148	537	126	1080	995	740	1093	85.2	79.8	188
1101	♀ ad	Sep 21	1590	113	490	134	870	860	490		77	72	160
1095	♂ juv	Sep 7	960	90	360	85	620	525	290	610	49	45	35
1072	♂ juv	Aug 20	1150	125	423	89	750	645			60.5	55.5	50

* *After skinning.*

MEASUREMENTS OF SKULLS

No.	Sex and age	Date	Condylobasal length[1]	Zygomatic width	Interorbital width	Length of nasal	Maxillary tooth-row	Mandibular tooth-row
1065	♂ ad	Aug 17	373	130	140	125	94	101
1144	♂ ad	Oct 16	356	135	140	122	82	
1111	♂ ad	Sep 29	359	134	138	112	82	
1046	♂ ad	Jun 18	374	131	135	121	97	104
1132	♂ ad	Oct 16	350	136	138	117	83	91
Average of ♂ ♂ ad			362.4	133.2	138.2	119.4	87.6	98.7
1101	♀ ad	Sep 21	324	117	121	101	85	
1036	♀ ad	Sep ——		118	120	83.5	79	83.5
1072	♂ juv	Aug 20	215	92	85	54		
1095	♂ juv	Sep 7	189	85	77	42		

[1] *Tip of premaxillary to posterior plane of condyles.*

MEASUREMENTS OF ANTLERS

No.	Sex and age	Date	Total length, right antler	Total length, left antler	Brow antler, length	Brow antler, width	Greatest spread of beams (outside measurement)	Total number of points
1065	♂ ad	Aug 17	1165°	1205°			875°	
1144	♂ ad	Oct 16	1200	1180	290	232	668	32
1111	♂ ad	Sep 29	1080	1080	279	235	655	32
1132	♂ ad	Oct 16	960	903	225	197	677	30
Average of last 3			1080	1054.3	264.7	221.3	666.7	31.3

° *Antlers in velvet. Unless otherwise specified, lengths of antlers were measured along the curve.*

MEASUREMENTS OF TESTES

Seasonal change in the size of testes in adult males is indicated by the following data: June 3, 30×18 mm.; June 18, 51×28.5; August 17, 50×35; September 29, 61×38; October 16, 60×40. Two male fawns: August 20, 18×7; September 7, 15×8.5.

References on measurements.—J. C. Ross, in John Ross, 1835*b*: xviii; J. A Allen, 1910: 8; Seton, 1929, **3**: 97; Sutton and Hamilton, 1932: 87; Flerov, 1934: 240; Murie, 1935: 75; Soper, 1944: 248; Banfield, 1951*a*: 30.

References on weight.—Parry, 1824: 305; Richardson, 1829: 241, and 1852: 290; Armstrong, 1857: 475, 498; Baird, 1857: 635; M'Clintock, 1860?: 184; Osborn, 1865: 227; Schwatka, 1885: 84-85; Collinson, 1889: 153; J. B. Tyrrell, 1892: 128; Whitney, 1896: 237; J. W. Tyrrell, 1908 (1898): 79; Jones, 1899: 329; Hornaday, 1904: 138, and 1914, **2**: 104; J. A. Allen, 1910: 8, Seton, 1929, **3**: 97-98; Critchell-Bullock, 1930: 55; Hornby, 1934: 105; Banfield, 1951*a*: 15, 30.

Geographical variation

The comparatively few specimens available indicate that different populations on the mainland, between Hudson Bay and the Mackenzie River, vary in size. Final judgment on the significance of this variation must await the accumulation of more and better material. The lack of topotypical material from the Fort Enterprise area, Mackenzie, is a particular handicap.

The extreme and average body measurements of five adult males from the Windy River area (see accompanying table) may be compared with those of three adult males, taken by R. M. Anderson, 1910 and 1912, at Langton and Darnley Bays (Nos. 34431, 34432, and 34435, Am. Mus. Nat. Hist.): length, 1980-2095 (2052); tail (two specimens), 152-165 (158.5); height at shoulder, 1066-1167 (1117); shoulder to hip (one specimen), 964. The average length of these specimens exceeds that of the Windy River specimens by 278 mm.; the average height at the shoulder, by 37 mm. The length of an adult male from Artillery Lake (J. A. Allen, 1910: 8) exceeds the Windy River average by 156 mm., and its shoulder height (Seton, 1929, **3**: 97), by 10 mm., but the length of its hind foot, as recorded, is 17 mm. less than the Windy River average.

The measurements of four adult females, taken by Anderson, 1910 and 1911, at Langton Bay, Horton River, and Great Bear Lake (Nos. 34429, 34434, 34441, 34442, Am. Mus. Nat. Hist.) are: length, 1625-1815 (1736); height at shoulder, 825-1066 (968); shoulder to hip (one specimen), 863. The average length of these specimens exceeds that of a Windy River adult female by 146 mm.; the average height at the shoulder, by 98 mm. The length of an adult female from Aylmer Lake (J. A. Allen, 1910: 8) exceeds that of the Windy River specimen by 112 mm.; the length of its hind foot, by 18 mm.; and the height at the shoulder (Seton, 1929, **3**: 97), by 43 mm.

Thus there appears to be a fairly uniform tendency toward greater body measurements from southwestern Keewatin to northwestern Mackenzie. The weight of Seton's male from Artillery Lake (270¾ lb.) considerably exceeds the maximum (200 lb.) that I estimated for any of the Windy River males. Maximum measurements are furnished by winter specimens from the region of Langton and Darnley Bays.

The skulls of two adult males from Horton River and Artillery Lake (Nos. 34502 and 29031, Am. Mus. Nat. Hist.) measure, respectively: condylobasal length (tip of premaxillary to posterior plane of condyles), 381, 371; zygo-

matic width, 138, approximately 142; interorbital width, 143, 144; nasal, 126, 112; maxillary tooth-row, 87, 84; mandibular tooth-row (of No. 29031), 93. The rostral profile of the former is slightly convex; of the latter nearly flat. Comparison with Windy River adult males (see accompanying table) indicates a longer and a broader skull in the more northwesterly specimens. The measurements of the skulls of Southampton Island specimens as presented by Sutton and Hamilton (1932: 87), suggest a somewhat larger animal than the mainland form.

The left antler of an adult male from Horton River (No. 34502, Am. Mus. Nat. Hist.) measures: length, 1248; length of brow tine, 345; width of brow tine, 360; total points (both antlers), 16+14=30. The corresponding measurements of two sets of antlers from Fort Reliance in the American Museum of Natural History are: No. 121471 (left), 1242-285-108; (right), 1244-412-294; total points, 16+23=39; No. 121473 (left), 1312-360-290 (broken); (right), 1230 (approx.), brow tine a spike, not palmated; total points, approximately 19+13=32. The Fort Reliance specimens were selected by George G. Goodwin from a large number of old antlers lying about, and they are naturally above the average in size. The antlers of adult males from the Windy River area (see accompanying table) measure distinctly less than those just mentioned.

Anderson (1913*b*: 505) and Stefánsson (1913*a*: 106, and 1913*b*: 241, 276-277) have called attention to certain rather well-defined differences between the Caribou on both sides of Coronation Gulf and those elsewhere in northern Mackenzie. It may be assumed that the summer home of the former type is on Victoria Island. Many of these animals in former years crossed over to the mainland in the autumn after the freezing of Dolphin and Union Strait, Coronation Gulf, and Dease Strait made such a migration possible; and they recrossed to the island in the spring. During recent years this migration has greatly dwindled (Blanchet, 1930: 50; Birket-Smith, 1933: 93; Clarke, 1940: 98; Gavin, 1945: 227; Godsell, 1937: 288; Banfield, 1949: 481); consequently the Victoria Island population now seems to be largely confined to that island throughout the year. In the American Museum of Natural History I have examined several of Anderson's specimens of 1911-1912 that are obviously of this form, and I should scarcely hesitate to give them nomenclatural recognition except for the fact that there has obviously been some confusion in the labeling of the specimens (after they reached the museum). Needless to say, a specimen selected as a type should bear unquestionable data.

During the winter there is some interchange of populations between Banks and Victoria islands across the frozen Prince of Wales Strait (Armstrong, 1857: 297, 336). The description that Armstrong gives (1857: 478), based ostensibly on Banks Island

specimens, indicates that the animals of that island are very close to, if not identical with, *Rangifer pearyi* of the more northerly Arctic islands. Yet there is no known interchange of populations across the frozen McClure Strait or other wide sea channels in approximately latitude 74° N.

The Caribou of Boothia Peninsula and Somerset and Prince of Wales islands are said to be a small form (Wright, 1944: 195).

The Caribou of the Dubawnt River region, as far as may be judged from J. B. Tyrrell's photographs (1897: pl. 1; Seton, 1929, **3**: pl. 22), are indistinguishable from those of the Nueltin Lake region.

The Southampton Island antlers figured by Sutton and Hamilton (1932: pl. 8) are so strikingly different from all but one (No. 1132) of those that I noticed in southwestern Keewatin that I should be much inclined to regard them as representing a separate subspecies, provided they are typical of that island. In most of the bucks of the Windy River area the beams are deeply and fairly uniformly bowed, although there is a strong tendency for approximately the basal third to be nearly straight, with a pronounced forward bend just above it (*cf.* figs. 3, 4, 9, 10, 12, 22, 25). The bend at this point in the Southampton antlers is extremely slight by comparison. In mainland specimens the beam in cross-section is generally more or less round, with rarely any tendency toward flattening, such as may be seen in the Southampton set and in my No. 1132. Furthermore, I cannot recall in the mainland animals a single such pronounced zigzag effect as may be seen in the Southampton antlers. In extremely few of them does the bez tine originate at such a distance (apparently 8 inches or so) above the base, as in Sutton and Hamilton's figure. The lack of palmation in the bez tines of their specimen is noteworthy.

There is a distinct likelihood that the isolated herd of Coats Island (Wright, 1944: 188; Banfield, 1949: 481), and also that of Salisbury Island in Hudson Strait (Grant, 1903: 189; Tweedsmuir, 1951: 37), may be distinct from the populations on the nearest large land bodies.

I have briefly examined a dozen or more heads (skulls with antlers) of the Labrador Barren Ground Caribou (*R. a. caboti* G. M. Allen) in the United States National Museum; they were collected by L. M. Turner in the 1880's. Some of these antlers appear longer than any I saw in Keewatin. Furthermore, the tips of the bez tines

in these specimens seem, on the average, more strongly incurved than in *R. a. arcticus.*

For the purpose of comparing the Barren Ground Caribou with the Western Woodland Caribou, *Rangifer caribou sylvestris* (Richardson), the following notes are offered on an adult male of the latter form in the United States Biological Surveys Collection (No. 235361; fig. 28). It was secured by a Cree Indian on Stony Mountain, about 27 miles south of Fort McMurray, Alberta, on October 21, 1920, and it was measured and prepared by myself. The general dorsal color is near Prout's Brown, overlaid more or less with longer whitish hairs; outer surface of ears near Prout's Brown, with an admixture of grayish white hairs; tip of snout, between nostrils and upper lip, Cartridge Buff; this area of more restricted extent than the similar patch in *arcticus;* neck creamy; longest hairs of throat fringe about 20 mm. (longer than in *arcticus*); no appreciable dark longitudinal stripe on lower sides, but an ill-defined lighter patch on the side behind the shoulder; rump-patch apparently less extensive than in *R. a. arcticus;* venter near Buffy Brown, posteriorly creamy; creamy white "spats" above hoofs ¼ to 1½ inches wide, not extending up hind leg as indicated by Seton (1929, **3**: pl. 10). Length, 2025; tail, 225; foot, 625; front hoof, 109; hind hoof, 101; estimated weight, 300 lb. The Western Woodland Caribou is thus a distinctly larger animal than *R. a. arcticus,* with a noteworthy difference in the virtual absence of a light lateral stripe, setting off a darker stripe below it. The specific distinctness between the two animals seems abundantly clear.

References to general descriptions (including geographical variation).—Richardson, 1829: 239, 241-242; Armstrong, 1857: 478; Baird, 1857: 635; Caton, 1881: 105; Lydekker, 1898: 47-48, 1901: 38-40, and 1915: 254; Elliot, 1901: 37, and 1902: 281-282, 286-287; Preble, 1902: 42-43; Stone and Cram, 1904: 52; J. A. Allen, 1908*a*: 488; Millais, 1915: 261; Buchanan, 1920: 125-126; Anthony, 1928: 530-531; Seton, 1929, **3**: 98-99; Jacobi, 1931: 78-80; Sutton and Hamilton, 1932: 88; Degerbøl, 1935: 48-51; R. M. Anderson, 1937: 103; Hamilton, 1939: 109; Murie, 1939: 239; G. M. Allen, 1942: 297-298; Wright, 1944: 195; Rand, 1948*a*: 211-212; Banfield, 1951*a*: 15-17; Mochi and Carter, 1953: text to pl. 9.

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Rangifer arcticus arcticus

These references are arranged chronologically, year by year; but within a given year, the arrangement for the most part is alphabetical by authors. The full citations of the publications (here designated merely by author and year) may be found in the preceding "Literature Cited."

The name or names at the beginning of each entry are those by which the animal is referred to in that particular publication. If the author supplies a technical name (such as *Rangifer arcticus*), that name alone is furnished here. The authority for the technical name is included or omitted according to the usage of each author.

If he omits a technical name, the common name or names he employs (such as "Caribou" or "Reindeer") are supplied.

In some of the earlier accounts, particularly, more than one form of *Rangifer* (*e.g.*, Peary's Caribou, the Labrador Caribou, or even the Woodland Caribou, in addition to the typical Barren Ground Caribou) may have been treated under a single designation, such as "Reindeer" or "*Cervus tarandus.*" In such case the word "part" is added in parentheses after the name at the beginning of the entry. As far as is possible or feasible, the references are here limited to *R. a. arcticus.* They constitute a partial summary of the nomenclatural history of the typical subspecies.

The annotations aim to provide a sort of abstract of, or unalphabetized index to, the treatment of this animal in each publication. Each topic or rubric of the annotations (such as migration, distribution, food, voice, antlers, or relation to Wolves) is accompanied by page references.

In the earlier part of the present publication, at the end of the discussion of each topic, references are given (merely by author, year, and page) to previous literature on the same topic. The Annotated Bibliographical References now supplied represent an amplification of those earlier and briefer references—an intermediate stage between them and the original literature. It is hoped that they will prove particularly helpful to those who may not have ready access to all the items of the original literature. My own coverage of the literature has not been by any means exhaustive; limitations of time and insufficient accessibility of some of the rarer publications have been the principal factors involved in this deficiency.

The chronological arrangement of the entries throws an interesting light on the gradual acquisition, during more than two centuries, of our present stock of information on the distribution, taxonomic characters, life habits, and general status of *Rangifer arcticus arcticus.* It may be remarked, however, that one of the very earliest accounts (Hearne, 1795) was one of the fullest. It contributes toward bringing into focus the remarkable attainments of that pioneer explorer-naturalist of the Barren Grounds.

"Deer" (one of three kinds): Isham, 1949 (1743): 151 (description); 152 (inhabit Barren Grounds); 152-153 (snares); 154 (Eskimos hunting with spears and arrows).

"Rain-deer" or "Cariboux": Dobbs, 1774: 9, 78, 94 (Marble Island); 19 (Indians living on Caribou W. of Hudson Bay); 20 (herds of up to 10,000

between Churchill and Nelson rivers); 22 (migration [of Barren Ground or Woodland species?] near York Factory—S. in March-April, N. in July-August); 47, 59 (N. of Churchill); 73-74 (Wager Inlet); 80 (Cape Fullerton).

"Deer": Hearne, 1795: 4, 7, 8, 14, 24 (vicinity of Seal River or Shethanei Lake); 28 (near Baralzon Lake); 35 (spearing by Chipewyans on upper Kazan River); 39, 40 (W. of upper Kazan River, July 22-30); 40-42, 50-52 (vicinity of upper Dubawnt River); 50 (skins suitable for clothing in late August); 56, 66 (vicinity of Egg River, Manitoba, November and December); 67-68 (E. of Nueltin Lake); 69, 72, (Nueltin Lake); 69 (flesh of bucks still unpalatable on December 30); 73, 74 (W. of Nueltin Lake, January); 76 (plentiful W. of Kasba Lake); 77 (Snowbird Lake); 78 (Indians living all winter on deer at Wholdaia Lake); 78-80 (description of a pound); 80-84 (deer in Indian economy); 84 (remoteness a barrier to trade in skins); 85-87 (W. of Wholdaia Lake, plentiful, March); 87 ("Thelewey-aza-yeth" Lake [on Thelon River], numerous, April); 96 (Indians living all winter on deer near Clowey Lake); 112, 114 ("Peshew" [Artillery?] Lake and vicinity); 117 (plentiful, vicinity of Thoy-noy-kyed and Thoy-coy-lyned lakes); 119, 123 (N. of Cogead Lake, where Indians kill deer at a river crossing); 139 (N. of Buffalo Lake); 141 (E. of Coppermine River); 142, 143, 147, 171 (Coppermine River and vicinity); 184 (Stony Mountains); 195 (Thaye-chuck-gyed Lake [Lac de Gras?]; great numbers killed); 196-197 (use for clothing, boots, tents, etc.); 197 (warbles eaten by Indians); 198 (rutting season in October; subsequent segregation of sexes); 198-199 (old bucks' antlers shed in November; young bucks still retain theirs at Christmas, and does till summer); 201, 204 (Point Lake); 222 (between Great Slave and MacKay lakes); 275 (large numbers reported on upper Taltson? River); 281 (W. of Hill Island Lake); 285, 286 (plentiful in April on Thee-lee-aza [Thelon?] River, NE. of Hill Island Lake); 293 (near Wholdaia Lake); 295, 296 (W. and E. of Kazan River); 297 (method of drying meat); 299 (plentiful in June, Nueltin Lake region); 300 (vicinity of Egg River, Manitoba); 316-319 (stomach contents, unborn young and uterus eaten by Indians); 321-322 (Indians driving deer between converging rows of sticks); 322-323 (tents of deerskin); 323-325 (skins used in manufacture of sledges, snowshoes, and clothing).

"Rein-deer": Parry, 1821: 273 (E. coast of Baffin Island).

"Reindeer" or "deer": Franklin, 1823: 215-227, 285 (Yellowknife River region); 230-232, 239-240, 245, 248, 268-271, 285, 297, 299, 309, 315-320, 438-440, 459-462, 480-488 (Winter Lake region); 233, 324-325, 418-426, 446-447 (Point Lake region); 240 (back fat; rutting season); 240-241 (antler and pelage change); 241 (larvae of warble and nostril flies); 241-242 (migration); 242 (fawning; food; weight; predation by wolves); 243-244 (Indian hunting methods); 327, 328, 333, 337, 344 (Coppermine River region); 327 (pursuit by a wolf); 344 (driven by wolves over a precipice); 363-374 (coast of Coronation Gulf); 379-395 (Bathurst Inlet region); 397-400 (Hood River region); 404-413 (Contwoyto Lake region); 478 (Marten Lake); 486, 487 (pursuit and killing by wolves, Winter Lake region).

Cervus Tarandas . . . : Sabine, in Franklin, 1823: 665, 667 (Barren Grounds, migrating in summer to Arctic islands).

"Deer" or "reindeer": Lyon, 1824: 48, 58-60 (Frozen Strait); 54 (Repulse Bay); 64-67 (Gore Bay; too fleet for a greyhound); 70, 74, 76, 77, 80, 82 (Lyon Inlet and vicinity); 119, 123, 130, 144, 203, 212 (Winter Island; food of Eskimos; bows made of antlers; use of sinews; deerskin clothing); 192-198, 217, 221, 223, 229, 238, 241, 282-283, 311-317 (Melville Peninsula, E. coast; deerskin clothing of Eskimos); 257, 269-270 (near Fury and Hecla Strait; buck shedding velvet, September 4); 324, 327 (Eskimo use of antlers in sledges and bows); 336 (Melville Peninsula, in summer; voice; inquisitiveness); 336-337 (Eskimo hunting with bow and spearing in water); 415, 419-423, 430, 436 (near Igloolik, Melville Peninsula, in June).

"Deer" or "reindeer": Parry, 1824: 42 (Southampton Island); 52, 61, 69, 71, 72, 83, 84, 92, 101, 106-108, 214, 230, 235, 236, 245, 254, 265 (s. Melville Peninsula and vicinity); 289, 305, 308, 324, 329, 332, 339, 343, 434, 438, 439, 441, 446, 447, 453-460 (Fury and Hecla Strait); 289 (stomach contents eaten by Eskimos); 305 (estimated weight 220 lb.); 380 (venison supplied by Eskimos); 403 (15 deer killed by an Eskimo during a summer); 494-497 (deerskin clothing of Eskimos, Melville Peninsula); 505 (their dependence on reindeer for food); 508 (Eskimo spear for killing deer in water); 512 (Eskimo methods of hunting deer); 513 (numerous, Cockburn Land); 537 (Eskimo use of skins and sinew).

Cervus tarandus L.: Richardson, "1825" (=1827?): 326 (native names); 327-328 (antler growth and change); 328 (rutting season and strong-tasting meat, about beginning of October; warble flies); 328-329 (migrations, in relation to attacks of parasitic flies and to food; does precede on northward migration); 329 (fawns born in May and June; stragglers in every part of the country at all seasons); 330 (utilization of Caribou —including fly larvae—as food by natives; nostril flies); 331 (marrow used as hair-dressing by native women).

Cervus tarandus . . . : J. C. Ross, 1826: 94 (North Somerset Island).

"Rein-deer": Franklin, in Franklin and Richardson, 1828: 54, 57, 60, 64, 71, 72, 288 (Great Bear Lake).

"Rein-deer": Richardson, in Franklin and Richardson, 1828: 200 (sinews used in Eskimo bows); 209, 218 (between Mackenzie River and Cape Dalhousie); 224 (Liverpool Bay); 231 (E. of Cape Bathurst); 241, 246 (near Cape Lyon); 249 (Cape Young); 255 (Dolphin and Union Strait); 269-273 (lower Coppermine River); 275 (stalking device of Hare Indians); 277 (Dease River); 282 (Great Bear Lake).

Cervus tarandus, var. α *arctica* Richardson: Richardson, 1829: 241-242 (original description); 239 (type locality, neighborhood of Fort Enterprise, Mackenzie); 241 (rutting season); 241-242 (antler change); 242 (pelage change; infestation with warble fly; foot click); 242-245 (economic uses of hide, flesh, bones, and antlers; migration; not wintering S. of Churchill); 242-244 (reproduction); 243, 245 (food); 245 (organization of herds; easy of approach); 245-249 (native methods of hunting).

Cervus tarandus L.: Godman, 1831, **2**: 283-284 (migration); 284 (food; gadfly attacking both Woodland and Barren Ground Caribou); 285-293 (quotations from Franklin, 1823).

"Deer" or "reindeer": John Ross, 1835*a*: 130-376, *passim* (Boothia Peninsula); 243-244 (Eskimo clothing of deerskin); 252 (Eskimo method of hunting); 328, 330 (only small numbers up to late April); 337 (many, early May); 352 (stomach contents as food for Eskimos); 376 (migrating N., May 26); 389 (large herd); 390 (hundreds, June 4); 402 (pursued and eaten by wolves); 432 (with fawns, June 10); 438 (many in June); 512 (many killed by Eskimos); 529 (many tracks, May 15); 530 (many passing, followed by a wolf); 534 (many, May 21, with two wolves); 537 (Eskimos killing deer in winter); 564 (a number pursued by a wolf); 612 (two, October 30); 628 (first tracks, March); 704 (tracks, Somerset Island, late June).

Cervus tarandus . . . : J. C. Ross, in John Ross, 1835*b*: xvii (great numbers, Boothia; weight 250 lb.; does arriving in April, bucks in May; fawns hunted by Eskimos with dogs; utilization by Eskimos; food; great numbers speared in water in autumn migration; stragglers found in winter); xviii (measurements).

"Rein-deer" or "deer": Back, 1836: 86 (Thelon River); 105 (Great Slave Lake); 116 (Hoar-frost River); 128-129 (near Artillery Lake, reindeer chased by wolves); 138-143 (Clinton-Colden and Aylmer lakes); 156-157 (head of Great Fish River); 178, 205 (near Fort Reliance); 216, 225, 234 (remaining on Barren Grounds near Great Slave Lake during winter); 261, 267, 268, 273, 280, 281, 285, 286 (Artillery Lake); 290, 292 (Lake Aylmer); 299, 307, 311, 320, 323, 325, 328, 337 (upper Back's River); 367 (lower Back's River, deer drowned in rapids); 420 (Chantrey Inlet); 435, 439 (lower Back's River).

Cervus tarandus Linn.: Richardson, in Back, 1836: 498 (Barren Grounds; migration; food); 499 (utilization by Indians and Eskimos; antlers).

"Reindeer" or "deer": Simpson, 1843: 76 (destruction in 1831 of a countless herd [of Woodland or Barren Ground species?] crossing Hayes River in summer); 196, 198 (Great Bear Lake, September); 206, 226, 232, 242, 247, 249, 250 (between Great Bear Lake and Coppermine River); 207 (solicitude of a buck for a wounded doe); 208 (antlers worn by Indian hunter as a decoy); 232 (deer driven over a cliff by wolves); 233 (numerous near Dease River, early April); 255, 256, 261, 264 (lower Coppermine River, June); 266, 271, 273 (Coppermine River to Cape Barrow, July); 277 (does apparently crossing the ice to islands for fawning); 278, 279 (Cape Barrow to Bathurst Inlet); 281 (first does with fawns seen, August 3); 284 (Bathurst Inlet); 295, 297, 301 (E. of Cape Franklin, migrating S., late August); 309, 310 (lower Coppermine River, September; drowned in rapids); 312 (deer snares, Dease River); 320-321 (retiring in winter to Coppermine River and country south of Great Bear Lake); 328 (numerous between Great Bear Lake and Mackenzie River in winter); 342 (between Great Bear Lake and Coppermine River, June); 347 (Eskimos hunting on Richardson River, summer); 352 (lower Coppermine River); 355 (Eskimos at Cape Barrow gone inland to hunt deer, July); 361 (Ellice River, July 31); 365,

367 (Adelaide Peninsula); 370, 374 (Elliot Bay); 379 (King William Island); 381 (does and fawns near Ogden Bay, early September); 382 (Melbourne Island); 386 (Victoria Island, early September); 391 (great numbers, lower Coppermine River, September 20).

"Rein-deer": J. McLean, 1932 (1849): 195 (immense herds [Woodland or Barren Ground sp.?] in York Factory region prior to 1837; their disappearance reducing Indians to want); 359 (Yellowknife Indians reported to have the art of taming fawns, which follow them like dogs till killed and utilized).

"Deer" or "rein-deer": Rae, 1850: 26, 27 (Rankin's Inlet); 27 (Eskimos spearing deer while crossing Chesterfield Inlet); 28 (Cape Fullerton); 31, 32 (near Whale Point); 35, 39 (Eskimo clothing of caribou skin, Repulse Bay); 40, 64, 65, 73, 74, 76, 80, 84, 91, 92, 133, 134, 166, 169, 177 (Repulse Bay); 44 (stone monuments erected by Eskimos to deflect deer); 44, 68, 99 (Rae Isthmus); 52, 54, 55, 130, 132, 145, 160, 161 (Committee Bay); 79 (use by Eskimos for clothing and food); 93 (migrating N., Repulse Bay, early March); 116 (Pelly Bay); 149, 151 (Melville Peninsula); 150 (use of stomach contents as food); 170 (Eskimo drum of caribou skin); 184, 186 (near Chesterfield Inlet).

"Deer": Osborn, 1852: 74 (near Pond Inlet).

"Deer": Rae, 1852*a*: 75 (Victoria Island, near Richardson Islands); 79 (many crossing Dolphin and Union Straits to Victoria Island).

"Deer": Rae, 1852*b*: 83 (lower Coppermine River); 91, 95 (Victoria Island, vicinity of Albert Edward Bay).

"Barren Ground reindeer": Richardson, 1852: 156 (Point Atkinson); 158 (Cape Brown); 166 (Franklin Bay); 173 (Buchanan River); 188 (Rae's River); 198 (Kendall River region); 290 (Great Bear Lake; weight; great numbers [of Woodland or Barren Ground species?] crossing Hayes River, 1833, and slaughtered there by Indians); 296 (Great Bear Lake, migrating N. in May).

"Reindeer" or "deer": Hooper, 1853: 296 (dried meat as winter fare at Fort Norman); 302 (few along Bear River, November); 342 (Kendall Island); 343 (Richard Island); 378, 381 (meat as winter fare at Fort Simpson); 391-393 (method of preparing pemmican).

"Rein-deer": Kennedy, 1853: 128 (numerous tracks, North Somerset, early April); 133 (Bellot Strait); 144, 150 (numerous, Prince of Wales Island, late April).

Rangifer caribou . . . (*C. tarandus, var. A. Arctica* Richardson): Audubon and Bachman, 1854, **3**: 114 (quotations from Richardson, 1829, and Hearne, 1795; "in every part of Arctic America, including the region from Hudson's Bay to far within the Arctic circle").

"Deer": J. Anderson, 1856: 24 (about 100, mostly bucks, Adelaide Peninsula, early August; Eskimos at Lake Franklin preparing to hunt deer); 25 (a few does at Lake Macdougall, mid-August; numerous at Aylmer and Clinton-Colden Lakes, early September).

"Deer": J. Anderson, 1857: 321 (Eskimos hunting deer, Lake Franklin, July 30); 322 (mouth of Back's River, July 30); 323 (fat bucks killed, Montreal Island, August 2-3); 324, 325, 327 (100, mostly bucks, Adelaide Peninsula, August 6, 7, 11); 326 (all tracks going S., August 9); 328

(25 going S., Lake Pelly; good deer passes between Lakes Pelly and Garry and at Hawk Rapids).

"Reindeer" or "Deer": Armstrong, 1857: 149, 154, 155 (Eskimos with Reindeer meat and skins, Point Warren, E. of Mackenzie River); 166 (skins and meat at Eskimo camp near Cape Dalhousie); 194 (deerskin clothing of Eskimos on coast of Mackenzie); 210, 316, 322, 384, 391, 395, 417 (Banks Island); 254, 335, 364, 365 (Victoria Island, in October, May, July, and August); 297, 336 (Prince of Wales Strait, January and May); 395 (predation by wolves, Banks Island); 475-488, 497-499, 505-510, 514, 515, 521-530, 545-556, 568 (Banks Island; maximum weight 240 lb.; distribution; remain during winter; fawning; 112 killed at Bay of Mercy; quality of meat varying with season; wariness; antler change; description; graze with heads to wind; pursuit by wolves).

Rangifer groenlandicus (Kerr) (part): Baird, 1857: 635 (description; weight); 635-636 (distribution).

Cervus Tarandus, var. α *arctica* Richardson: Murray, 1858: 191 (Chesterfield Inlet region); 193-198 (comparison with Lapland reindeer); 199-206 (antlers and shedding); 201-204 (quotations from previous literature on antlers, food, fawning season, and winter range); 206 (teeth); 206-210 (fur); 210 (damage by warble flies).

"Reindeer" or "deer": M'Clintock, 1860?: 147 (s. shore of Pond Inlet); 167, 176, 177, 184-188, 191, 194, 201, 203, 217, 289, 290, 295, 299 (Bellot Strait); 184 (buck at Bellot Strait, minus paunch, weighing 354 lb.); 212 (Eskimo clothing of reindeer skins, Boothia Peninsula); 219 (Somerset Island); 239 (Adelaide Peninsula); 244 (Montreal Island); 245 (Chantrey Inlet); 252, 279, 280 (King William Island).

"Rein-deer" (part): Richardson, 1861: 274 (migration; rutting season; utilization by Indians and Eskimos); 275 (moving N. at Repulse Bay, March 1; food).

Rangifer arcticus . . . : B. R. Ross, 1861: 438 (between Hudson Bay and Arctic Ocean; infested by larvae of warble and nostril flies); 438-439 (migrations); 439 (antler and pelage change; food); 439-440 (value to Indians for food, clothing, etc.).

Rangifer Groënlandicus . . . : B. R. Ross, 1862: 141 (distribution).

"Reindeer" or "deer": Osborn, 1865: 70 (Cape Bathurst); 80, 110, 162, 170, 173, 182, 186, 188, 189, 192, 199, 206-208, 219 (Banks Island); 98, 139, 146 (Victoria Island); 112 (Prince of Wales Strait, January); 223-224 (resident in Arctic archipelago, including Banks Island); 226 (no migration across Barrow Strait or Melville Sound); 227 (weight; gait; antler change; fawning); 227-228, 231, 232 (wolf predation).

"Reindeer": Kennicott, in Anonymous, 1869: 166 (dried reindeer meat one of chief foods at Fort Simpson); 170 (caribou clothing used by Yellow Knives).

Rangifer tarandus (Linné) Bd.: Kumlien, 1879: 19 (Eskimo hunting at Cumberland Sound); 23-25 (Eskimo clothing of deerskin); 36-37 (Eskimo arrows and bows of antlers); 53, 54 (pursuit by wolves); 54 (abundant in Cumberland Sound region; migration; food; hunting and utilization by Eskimos).

"Barren ground caribou": R. Bell, 1881: 15C (migrating in great numbers, Reindeer Lake).

Rangifer Groenlandicus "Baird" (part): Caton, 1881: 105 (description); 106 (Mackenzie River to Hudson Bay); 107 (food); 108 (habits; migration); 366-371 (hunting by Indians and Eskimos).

"Reindeer" or "deer": Gilder, 1881: 11 (Eskimos near Lower Savage Islands, Hudson Strait, with skins and meat); 23, 25, 26, 28 (hunting by Eskimos near Connery River, Keewatin); 42, 46 (near Chesterfield Inlet); 43 (Eskimo drum of deerskin); 50 (dog harness of deerskin); 59, 61, 64, 67, 71 (522 reindeer killed by Schwatka's party between Hudson Bay and King William Island); 61 (pursued by wolves); 78 (wariness in winter); 83, 192 (Adelaide Peninsula); 122, 132, 153, 157, 161, 162 (King William Island); 137-146 (Eskimo use of skins and meat); 154 (Eskimos use of fat and meat); 196-197 (reindeer collecting in immense herds to cross Simpson Strait on ice in early October); 217, 218 (lower Back's River, December); 223, 224, 225, 226 (numerous between Back's River and Chesterfield Inlet, January); 254-255 (deerskins as Eskimo bedding).

"Reindeer" or "deer": Nourse, 1884: 220 (Eskimos dressing skins near Wager Bay); 232 (37 killed by Hall's party in July, Wager Bay); 235 (a thousand passing in a day; many cached near North Pole River, late September; seen from September to January, and reappearing in March); 256 (deer-hunting, Melville Peninsula); 264-265 (18 deer and a fawn near Cape Weynton); 351 (found abundant by Schwatka between Wager Bay and Back's River); 354 (King William Island); 356 (plentiful, Terror Bay; immense herds, Simpson Strait, September to October 14).

"Reindeer" or "Arctic deer": Schwatka, 1885: 59-60, 65, 67-71, 73-75, 81-82, 86 (hunting by Eskimos and whites in n. Keewatin); 60-64 (skins for clothing, bedding, and drums); 60-61 (molt); 65, 67 (use of meat); 68, 71-72 (swimming); 72 (many on King William Island); 77-79 (migrating across Simpson's Strait, June and October); 79 (Boothia and North Somerset); 81 (near mouth of Back's River); 83 (rarely seen in herds of more than 100; migrations); 84-85 (weight); 85 (unwariness).

"Deer": Boas, 1888: 419 (deer in Eskimo economy); 429, 461-462, 501 (Baffin Island; hunting by Eskimos in summer by spear or line of cairns); 438 (varying numbers on Cumberland Peninsula); 502 (migration, Baffin and King William Islands); 502-503 (bows made of antlers); 508-509 (stalking and trapping by Eskimos); 522 (dressing of skins by Eskimos); 555-560 (clothing of deerskin).

"Reindeer": Bompas, 1888: 24 (deflected in their migrations in Mackenzie district by burning of the country); 60 (attacked by wolves); 61 (Indian methods of hunting); 62 (palatability of the flesh); 100 (utilization of hides and meat).

"Deer": Collinson, 1889: 153 (Banks Island; weight); 166, 171, 173-175, 181, 186, 197, 209, 220, 237, 264, 272-274 (Victoria Island); 200, 203, 229 (Prince of Wales Strait); 235 (Dolphin and Union Strait); 243, 247, 281, 283 (Cambridge Bay); 244 (large herds waiting to cross Dease Strait, October; trailed by wolves); 277 (stone monuments of

Eskimos for deflecting deer, Dease Strait); 290 (large numbers migrating in autumn from Victoria Island to mainland).

"Reindeer": MacFarlane, 1890: 32-34 (Anderson River; Eskimos hunting reindeer there; their clothing in part of deerskin); 38 (Eskimo fish nets of deer sinew); 38, 43, 47 (numerous on Anderson River).

"Barren Ground caribou": Pike, 1917 (1892): 43, 64 (near Lake Mackay); 44-46 (Lake Camsell); 48 (Arctic islands to s. part of Hudson Bay and vicinity of Fort Smith, W. to Mackenzie River; rutting season in October); 48-49 (migration); 49 (segregation of sexes; antler change); 50 (migration deflected by burning of country; thousands [Barren Ground or Woodland species?] at York Factory, about 1888-1890; depletion by hunting); 51-55 (Indian methods of hunting; economic uses); 51-52, 90 (unwariness); 56-58 (relations to Eskimos, wolves, and wolverines); 58-59 (parasitic flies); 59-60 (Indian superstition); 67, 72 (Coppermine River above Lac de Gras); 76 (near Lake Mackay; Lake Camsell); 81-82 (S. of Lake Mackay; curing of meat and hides); 89-91 (la foule); 90 (rutting season over and bucks too strong to eat, late October); 101 (mostly passed into the woods by November 11); 108 (Lake Mackay); 134 (near Lac de Mort); 148 (near Gros Cap, Great Slave Lake, January); 171, 174, 177 (N. of Great Slave Lake); 174 (bucks leaving woods in early June); 182 (Lake Aylmer); 186, 199 (Back's River, July); 201, 204 (near Lake Beechey; females with young, late July); 209 (females and young in great numbers, upper Back's River); 217 (Clinton-Colden Lake, early August); 220 (thousands at Ptarmigan Lake, August); 221 (Artillery Lake); 224, 227 (Pike's Portage).

Rangifer Groenlandicus Linn.: J. B. Tyrrell, 1892: 128 (use in economy of northern Indians; weight; antler shedding; pelage change; infestation with warbles); 129 (wintering between Churchill River and Lake Athabaska; collecting on frozen lakes); 130 (Indian hunters killing 100-400 apiece; Fond du Lac, Lake Athabaska, on a main migratory path).

Rangifer Groenlandica Linn.: Dowling, 1893: 89 (Bear Head Lake [N. of Great Slave Lake]); 92 (near Lake Mackay, June 22); 103 (a favorite crossing on Great Fish River near Musk-ox Lake); 107 (Pike's expedition living mainly on caribou; migrations; does fawning near the seacoast, bucks following behind; horns in velvet prized as food by Indians).

"Barren Ground caribou": J. B. Tyrrell, 1894: 441 (*Alectoria jubata*, a lichen, at Daly Lake, as food of caribou); 442 (immense herd—"tens of thousands"—at Carey Lake, July 29; tormented by black flies; animals lean and poor); 445 (Eskimo wearing deerskin coat; Lady Marjorie Lake, lower Dubawnt River); 446 (caribou plentiful in country traversed as far as Baker Lake; last one shot there September 3).

"Barren Ground Caribou": Russell, 1895: 48 (a mass of caribou passing Fort Rae for 14 days in 1877); 49 (a section of antler used by Indian as a powder horn); 49-50 (caribou N. of North Arm of Great Slave Lake, November); 50 (leaping high in air at start; Indian hunting methods); 51 (Indian use of meat; albino specimen; antler growth

and shedding; thousands near Bathurst Inlet, April; does fawning along sea coast in June).

"Deer": J. B. Tyrrell, 1895: 440 (deer meat bartered by Chipewyans at Brochet); 442-443 (Indians hunting deer at Ennadai Lake; large numbers encountered there; Eskimos skinning deer on upper Kazan River); 444 (deerskin clothing purchased from Eskimos on Kazan River); 445 (no deer seen in rocky country along Ferguson River).

Rangifer Graenlandicus . . . : J. B. Tyrrell, 1896: 13 (S. in winter to Reindeer Lake and Mudjatick and Foster Rivers); 63 (migrating past Fond du Lac, Lake Athabaska).

"Caribou": Whitney, 1896: 157, 238, 241 (migrations); 161 (fat, pemmican, and dried meat); 175 (use of dried meat by Dogribs); 176 (tepees of caribou skin); 202-206 (vicinity of Fort Enterprise); 210 (near Point Lake); 210, 213 (Dogrib hunting methods); 237 (importance to Indians; weight; an albino); 238-239 (antler shedding); 239 (warble and nostril flies; persecution by wolves); 240 (seasonal condition of flesh; distribution; recent decrease); 242 (wasteful killing by Indians; variation in wariness); 252, 268-269 (S. of Coronation Gulf); 262 (shoulder-blade as Indian talisman).

Rangifer Groenlandicus . . . : J. B. Tyrrell, 1897: 10, 49-50, 165 (herd of 100,000 to 200,000 at Carey Lake, Dubawnt River, late July); 12 (plentiful near Thelon-Dubawnt junction; scarce at Baker Lake, early September); 14 (S. of Dawson Inlet); 19, 124 (large numbers, Ennadai Lake, mid-August); 21, 140, 142 (plentiful along Ferguson River, September); 76 (plentiful along Dubawnt River); 122, 131-132 (hunted by Chipewyans, Ennadai Lake and Kazan River); 126-127, 131-132 (hunted by Eskimos, upper Kazan River); 134 (many near Yathkyed Lake); 150-151 (near source of Owl River, Manitoba; hunted by Indians, Wapinihikiskow Lake); 166-167 (hunting by Chipewyans and Eskimos; use for food, clothing, and kayaks).

Rangifer tarandus arcticus . . . : Lydekker, 1898: 47-48 (description); 48 (distribution); 48-49 (migration; food).

Rangifer tarandus (Linn.): Russell, 1898: 88 (great numbers passing Fort Rae for 14 days in 1877); 89 (N. of Fort Rae); 90 (leaping into air at start); 91 (use of flesh by Dog Ribs; albino specimen); 111, 113, 119 (upper Coppermine River region, abundant in March); 134 (caribou-skin clothing worn formerly by Loucheux at Fort McPherson); 139 (on Mackenzie Delta in 1850); 168 (caribou-skin lodge at Fort Rae); 169-172 (caribou-skin clothing among Dog Ribs); 176 (caribou-skin drum at Fort Rae; use of sinew); 178 (caribou-skin gun cases among Indians); 187-189 (caribou-skin clothing among Eskimos); 225 (antler change); 226 (albino; food; distribution and migrations); 227 (abundant along coast between Mackenzie River and Cape Bathurst, 1894; deer snares; spearing; hunting); 228-229 (utilization by Eskimos and Indians; parasitic flies).

"Barren Ground Caribou," "deer," or "reindeer": J. W. Tyrrell, 1908 (1898): 77-78 (Barlow Lake; Carey Lake, thousands, late July); 79 (weight 100-400 lb.; molt); 79-80 (antler change); 80 (relation of prongs to age; migration; food; reproduction); 80-81 (utilization of meat, skins,

and sinew); 87-88 (Dubawnt Lake); 97 (lower Dubawnt River); 98 (Wharton Lake); 123-138 (utilization by Eskimos); 139-141 (hunting by Eskimos); 174-177 (near Dawson Inlet); 206-207 (E. of Churchill River); 215 (mouth of Nelson River [Woodland or Barren Ground species?]); 241 (importance to natives).

"Caribou" or "reindeer": Jones, 1899: 328-332, 342-343, 353-355 (Fort Reliance and vicinity); 329 (weight); 338, 340, 365, 394 (Artillery Lake and vicinity); 342 (Indian corral or trap); 359 (noonday rest of caribou); 368 (immense band, Clinton-Colden Lake, early March); 374 (tens of thousands of does daily, Clinton-Colden Lake, moving N., March); 374-375 (relations to wolves); 381 (abundant, near mouth of Dubawnt River, March); 390 (near lower Dubawnt River); 411 (suffering from insects); 429 (spearing by Indians).

"Deer": Lofthouse, 1899: 275 (mouth of Tha-anne River, early July).

"Caribou or deer": Hanbury, 1900: 64 (Eskimos bringing venison to Churchill and reporting deer numerous along the coast); 65 (importance of deer in northern travel; scarce along west coast of Hudson Bay in May and early June); 66-67 (very scarce at Baker Lake in June, plentiful in July); 67 (flesh unpalatable in fly-time; large bands at Aberdeen Lake, August); 69 (absent in winter on lower Thelon River; very scarce on Hanbury River, August); 71 (plentiful, Artillery Lake to Great Slave Lake, September).

Rangifer arcticus (Richardson) (part): A. J. Stone, 1900: 50 (distribution; migration); 51 (Richards Island); 53 (antlers; does and fawns moving N. in May, Franklin Bay; sprawling posture of hind leg); 57 (disastrous results of whalers' demands for meat; Darnley Bay; Bathurst Isthmus).

"Caribou": J. M. Bell, 1901*a*: 16 (vast herds near Dismal Lake; use by Eskimos).

"Caribou": J. M. Bell, 1901*b*: 252 (furnishing food and clothing for Hare Indians, Great Bear Lake); 255 (use by Eskimos near Coppermine River; vast herds); 258 (plentiful, but decreasing, S. of Great Bear Lake; wanton killing by Indian and Eskimos).

"Caribou": Boas, 1901: 52, 54 (Eskimo garments of caribou skin, Cumberland Sound); 81 (Eskimos hunting caribou with harpoons); 102, 107 (Eskimo clothing of caribou skin, w. coast of Hudson Bay); 150 (albino caribou).—1907: 465 (Eskimos W. of Hudson Bay dependent on caribou); 474 (caribou plentiful on Southampton Island and larger than on mainland); 493 (caribou-hunting at Pond's Inlet); 501 (taboo against killing albino caribou, W. of Hudson Bay).

[*Rangifer*] *arcticus* (Rich.): Elliot, 1901: 37 ("Barren grounds of Arctic America, north of the tree limit, to the shores and islands of the Arctic Ocean"; diagnosis).

Rangifer tarandus arcticus . . . (part): Lydekker, 1901: 38-40 (description).

"Reindeer and caribou (Rangifer caribou)": W. J. McLean, 1901: 5 (Great Slave Lake, annual arrival on August 12; hunting and utilization by Indians); 6 (antler growth and change; migration; trails; swimming).

Rangifer tarandus . . . (part): Beddard, 1902: 298 ("circumpolar").

Rangifer arcticus . . . : Elliot, 1902: 259 ("in 1856 they migrated to latitude 47° in great numbers to Lake Huron" [???]); 260, 274-275 (migra-

tions); 273 (Arctic regions, W. to Coppermine and Mackenzie Rivers); 276 (food; fat); 276-277 (utilization by Indians and Eskimos); 277-279 (native hunting methods); 279-280 (antlers shed by old bucks in December and January, carried by young bucks till spring, and by does till birth of fawns); 281-282, 286-287 (description).

Rangifer arcticus (Richardson): Preble, 1902: 41 (50 and 25 miles S. of Eskimo Point; pursued by wolves; attacks of insects); 42 (flashing a white throat-patch; summation of previous records; ranging S. to Churchill River and Reindeer Lake); 42-43 (pelage described).

"Caribou": J. W. Tyrrell, 1924 (1902): 15 (Fort Reliance, Great Slave Lake); 17 (Pike's Portage); 18-20 (Artillery Lake); 26 (nearly all gone farther N., only stragglers remaining along Hanbury River, early July); 27-28 (numerous tracks but few animals, middle Thelon River, early July; hundreds killed by spring ice or Eskimos); 31 (large band moving S., Thelon River, July 23); 33-35 (between Thelon River and Artillery Lake); 37 (great bands of caribou the chief food supply in Thelon River region).

Rangifer articus . . . (part): Grant, 1903: 186 (Barren Grounds W. of Hudson Bay, W. to Mackenzie River, S. in winter to Churchill River and Reindeer Lake; threatened with extinction by whalers); 189 (Salisbury Island).

"Deer": Hanbury, 1903: 185 (between Lake Pelly and Arctic coast, May).

"Caribou" or "deer": Hanbury, 1904: 8 (Marble Island and Chesterfield Inlet, June); 9 (Baker Lake, July); 10 (large bands migrating S., Aberdeen Lake, early August); 14 (scarce, Hanbury River); 16 (plentiful, Lockhart River); 30 (Pike's Portage, late July); 31 (Artillery Lake); 32 (Abbott Lake; scourged by warble flies); 34 (large bands migrating S., Hanbury River, late July); 41 (hunted by Eskimos near Thelon-Dubawnt junction); 43-44, 47 (Schultz Lake); 43 (voice; spearing by Eskimos); 48 (scarce, Baker Lake, early September); 49 (Chesterfield Inlet); 51 (plentiful near Marble Island, mid-September); 58 (leaving the coast, late September); 67 (dressing of skins by Eskimos); 70, 72 (killed by Eskimos, Baker Lake); 73 (thousands at Baker Lake; fierce combats between old bucks in October rutting season); 75 (deerskin roof of igloo); 82 (deerskin clothing of Eskimos); 84, 88-90 (NW. of Baker Lake, November); 85 (unwariness); 89 (pursuit by wolves); 93 (bucks remaining all winter on Back's River); 95 (numerous, Chesterfield Inlet; in December the old bucks had dropped their antlers); 100 (near Depot Island); 104-107 (Chesterfield Inlet region); 108 (does migrating N. in April); 111 (plentiful, Baker Lake, March); 113 (many, Schultz Lake, March); 114-115, 123 (snow pitfalls made by Eskimos); 115, 116 (numerous, Aberdeen Lake, March); 116 (antlers of bucks commencing to grow); 118 (NW. of Aberdeen Lake; buck weighing 280 lb.); 119 (Buchanan River); 120 (migration; many remaining on Barrens all winter; deer meat essential to Eskimos on Back's River); 121 (frequent famine among Indians and Eskimos; caribou formerly migrating S. and W. to Forts Simpson and Providence); 127-131 (Pelly Lake and vicinity); 131 (antics; jumping and trotting); 133-137 (near Ogden Bay); 133 (majority of does shedding antlers by late April);

135 (ravens feeding on carcasses); 137 (warbles eaten by Eskimos); 139 (caribou wintering on Kent Peninsula, at Cape Barrow, and on Victoria Island); 143 (Arctic coast Eskimos going inland, summer and fall, to live on deer); 149 (White Bear Point); 153-167 (mainland near Kent Peninsula); 164-174 (Bathurst Inlet); 177, 185-197 (scarce, Cape Barrow to Coppermine River); 194 (molting, July; suffering from mosquitoes); 200-208 (lower Coppermine River); 209, 210 (Kendall River); 215-221 (Dismal Lake); 223, 229-233 (Dease River); 232 (rubbing trees).

Rangifer arcticus . . . (part): Hornaday, 1904: 136 (Great Bear and Great Slave Lakes to Cape Bathurst); 137 (Carey Lake; migration); 138 (weight; antlers).

Rangifer arcticus (Richardson): Stone and Cram, 1904: 52 (description; Arctic islands to Hudson Bay and Mackenzie River; migration; rutting in October; sexual segregation); 53 (food; Mackay Lake; grunting). (Chiefly quoted from Pike, 1892.)

Rangifer arcticus (Richardson) (part): Elliot, 1905: 401 ("Barren grounds of Arctic America north of the tree limit, to the shores and islands of the Arctic Ocean").

Rangifer arcticus (Richardson): MacFarlane, 1905: 680 (Mackenzie Basin; depletion through wanton slaughter by Indians); 681-682 (Anderson River, in winter; hunting and utilization by Eskimos and Indians); 682-683 (albino); 683 (trade in skins; wintering at Prince of Wales Strait and Mercy Bay, Banks Island; migration between Arctic islands and mainland); 684-685 (table of migration at Reindeer Lake); 692-693 (predation by wolves).

R[*angifer*] *arcticus* . . . : J. A. Allen, 1908*a*: 488 (specimens from near Wager River described); 490 (migration).

Rangifer arctica (Richardson): J. A. Allen, 1908*b*: 584 (type locality, Fort Enterprise).

"Reindeer": Amundsen, 1908, **1**: 76 (Boothia); 83-84 (King William Island, September); 97 (reported formerly at Simpson Strait in large herds in autumn); 99 (20 killed, King William Island, late September); 102-106 (common in October, passing S. over Simpson Strait; very shy; no wolves on King William Island); 120 (Eskimos trading skins); 200 (King William Island, first reindeer of season seen, June); 201 (supplied by Eskimos); 224 (Simpson Strait); 235, 241-243 (King William Island, September); 237 (Eskimos hunting in September); 247 (large herds passing over ice of Simpson Strait); 248 (King William Island, October 15); 326-329 (hunting and utilization by Eskimos in Boothia; few reindeer coming N. as early as May).—1908, **2**: 110 (many killed by Eskimos, King William Island); 311-316 (several, April); 322-325 (Royal Geographical Society Islands).

Rangifer arcticus (Richardson) (part): Preble, 1908: 137 (Barren Grounds and islands northward; Great Bear Lake to Hudson Bay; economy; probably two or more races; E. of Fort Smith in winter; long ago S. to Fort McMurray); 138 (in 1902-03 to Cree Lake; large numbers, Great Slave to Great Bear lakes; lower Coppermine River); 139 (mi-

gration); 139-143 (summation of previous records); 214 (wolves living largely on caribou).

Rangifer arcticus (Richardson): J. A. Allen, 1910: 8 (7 August specimens from Artillery and Aylmer lakes; measurements and weight).

Rangifer arcticus (Richardson): Seton, 1911: 206-262, 341 (Artillery, Ptarmigan, Clinton-Colden, and Aylmer lakes; habits); 210 (voice); 220, 258-260 (numbers); 225-226 (relation to wolves); 259-262 (slaughter by natives and whalers).

Rangifer arcticus . . . : Cameron, 1912: 127 (place in economy of Caribou-eater Chipewyans; migration; on Lake Athabaska in winter); 309 (Fort Rae as a "meat-post" for the Mackenzie District).

"Caribou": Wheeler, 1912: 199 (Fort Enterprise and Coppermine River; 1910 a very poor caribou year; females and yearlings taken in April; females [only?] wintering between Rae and Enterprise, and largely exterminated; usual numbers in 1911; large migration of males commenced May 18); 200 (between Coppermine River and Bathurst Inlet; by June 10 all caribou beyond [N. of] Coppermine River).

"Barren ground caribou": R. M. Anderson, 1913*a*: 5 (recent great decrease); 6 (stragglers left in Mackenzie Delta region; great diminution along Arctic coast E. to Cape Parry, since recent advent of whaling ships; great numbers on Victoria Island in summer, crossing to mainland for winter; Great Bear Lake and Coppermine River; drives and spearing by Eskimos); 6, 8 (importance to Eskimos for clothing and meat); 8 (poor sight of caribou; hunting methods).

Rangifer arcticus (Richardson): R. M. Anderson, in Stefánsson, 1913*b*: 502 (importance in native economy; recent enormous decrease; few left in Eskimo Lakes region, on Cape Bathurst, and at Langton and Darnley Bays; great number in summer on Victoria Island, migrating to the mainland); 503 (Great Bear Lake; Coppermine River; occurrence on Arctic coast at any season; Eskimos driving them between lines of stone monuments into water and there spearing them); 504 (hunting methods; senses; infestation by bot-fly); 504-505 (fawning); 505 (geographical variation; antler growth and change); 505-506 (fat); 516 (relations to wolves).

"Caribou": Stefánsson, 1913*a*: 93 (ravens in Arctic feeding on caribou left by wolves); 94 (caribou moving N., Prince Albert Sound, Victoria Island, May 12); 95-96 (migrating across Dolphin and Union Strait, March and May); 99 (plentiful on Dease River, winter of 1910-11; abundant on lower Coppermine River, March; no great numbers cross central Coronation Gulf; wintering on coast E. of Coppermine; many moving N. across w. Coronation Gulf and Dolphin and Union Strait, April and May, and w. Victoria Island, May); 100 (migration across Kent Peninsula and in se. Victoria Island); 102 (E. of Cape Bexley); 103, 106 (numbers wintering on Banks Island, but few or none on Victoria Island); 105 (Eskimos hunting caribou in summer on s. Victoria Island); 106 (caribou wintering from Cape Bathurst to Kent Peninsula; migration N. across Coronation Gulf and Dolphin and Union Strait, April 1-May 20, and S. in the fall as soon as the ice is strong enough; tens of

thousands on Dease River in late October; differences between Victoria Island and mainland specimens).

"Caribou": Stefánsson, 1913*b*: 27 (Fort Smith a "meat post"); 29 (abundant at Fort Norman 50 years previously); 127, 128, 156, 158 (Langton Bay); 130, 135, 137, 141, 142 (Horton River); 146 (Cape Parry); 151 (extreme scarcity of hornless caribou); 163 (Cape Lyon); 164 (Port Pierce; human eye keener than caribou's); 203 (summer hunting by Eskimos S. of Dolphin and Union Strait); 203-204 (migration N. to Victoria Island); 204 (bot-fly larvae); 205 (near Dolphin and Union Strait); 210, 212, 213 (lower Coppermine River); 212-213 (seeking protection from mosquitoes on snow banks); 214 (Dismal Lake); 215 (summer hunting by Eskimos on Dease River); 219 (Great Bear Lake); 221 (August skins for Eskimo clothing); 224-225 (hundreds of thousands, Dease River, October); 228, 235 (N. of Great Bear Lake); 231, 232 (Horton River); 238, 239 (Kendall River); 241 (lower Coppermine River); 241-244 (geographical variation in caribou); 263-265, 269 (migrating N. across Coronation Gulf and Dolphin and Union Strait, early May); 274, 278, 287, 289, 297, 298, 301 (Victoria Island); 276-277 (variation from mainland animals); 278 (habitual wariness); 281 (caribou-skin tents and Eskimo hunting, Victoria Island); 289 (Banks Island); 294 (few on Victoria Island in winter); 324 (Cape Parry); 333 (Langton Bay; skins spoiled by warble fly larvae, June and early July; skins thick in summer and fall); 335 ("Endicott" [=Melville] Mountains); 337-338 (Eskimo methods of hunting and curing meat); 348-350 (migrating NW., Horton River, October); 364 (Langton Bay, February-March).

Rangifer arcticus (Richardson): Chambers, 1914: 93 (immense herd, between Churchill and Owl River, December); 291-294 (Great Bear and Great Slave Lakes); 294 (Mackenzie Delta region); 342-350 (summation of records on the Barren Grounds).

"Caribou": Douglas, 1914: 103, 167, 168, 179, 180 (Dease River); 121, 190, 192, 196, 214 (lower Coppermine River); 137 (Great Bear Lake); 157, 158 (very scarce, Great Bear Lake, winter); 185 (Dismal Lakes); 191-192 (larvae of warble and nostril flies).

Rangifer arcticus . . . (part): Hornaday, 1914, **2**: 97 (importance to Indians); 100 (the great mass between Cape Bathurst and Great Slave Lake; tens of thousands killed by natives for whalers); 101-104 (migrations); 103 (voice); 104 (tameness of large numbers; weight); 225-226 (numbers).

"Caribou" or "deer": Stefánsson, 1914: 13 (former abundance from Mackenzie River eastward); 26 (scarce near Rae River); 39 (common the year round on Banks Island; abundant in summer, but scarce in winter, Victoria Island); 41 (migrating S. across Coronation Gulf in November); 48 (stomach contents and droppings eaten by Eskimos, Coronation Gulf); 54 (crossing ice in migrating N., April and May); 56 (chief source of Eskimo food in summer, Coronation Gulf); 57 (hunting with spear and bow); 58 (poor eyesight); 58-59 (use as food by Eskimos); 97 (kayak used in spearing caribou); 137, 139 (former hunting in Mackenzie Delta region); 140-141 (skin clothing in Mackenzie Delta region); 147-148 (methods of removing and drying skins, Mackenzie

Delta region); 150 (use of skins and sinew); 275 (status about Great Bear Lake); 296 (droppings and warbles eaten by Eskimos, Victoria Island); 353 (caribou taboos); 355-356 (many on Mackenzie coast).

"Caribou": Wheeler, 1914: 52 (Dog-rib clothing of caribou skins); 54 (between Forts Rae and Enterprise); 56 (Fort Rae's early trade in caribou meat and skins); 58 (countless thousands, moving E., Great Slave Lake; Indian use of meat); 60 (caribou scarce N. of Great Slave Lake after burning of country); 65 (plentiful, Little Marten Lake); 67 (near Lake Providence).

Rangifer arcticus . . . : Harper, 1915: 160 (Tazin-Taltson Basin).

Rangifer tarandus arcticus (Richardson): Lydekker, 1915: 254 (bibliographical references; type locality; description; Baffin Island).

Tarandus rangifer arcticus (Richardson): Millais, 1915: 255-256 (considered conspecific with Woodland Caribou); 258, 263 (supposed interbreeding with Woodland Caribou); 261 (description; in winter ranging "west to the Rockies above Fort Vermilion"[!]).

"Barren Ground Caribou": Camsell, 1916: 21 (Tazin-Taltson Basin, autumn and winter).

Rangifer arcticus . . . (part): Nelson, 1916: 460 (Arctic barrens; numbers; Artillery Lake; gait); 460-461 (use as food).

"Rein Deer": Thompson, 1916: 19 (Eskimo lances pointed with leg-bone); 99 ([Barren Ground or Woodland species?] numerous in spring on Hayes River, where snared by Indians); 100-101 (immense herd estimated at 3,564,000 individuals, crossing Hayes River 20 miles above York Factory in late May, 1792).

"Caribou": J. B. Tyrrell, in Thompson, 1916: 16 (Eskimos on Kazan River subsisting chiefly on caribou, killing them with spears and using their skins for clothing and kayaks).

Rangifer arcticus . . . : Kindle, 1917: 107-108 (tens of thousands E. of Slave River, early winter); 108-109 (previous accounts of great numbers).

"Barren Ground Caribou": Camsell and Malcolm, 1919: 46 (e. border of Mackenzie Basin; migration).

"Barren Ground caribou": Malloch, 1919: 55-56 (larvae of *Oedemagena tarandi* from skin of caribou, Dolphin and Union Strait, Bernard Harbour, and Coronation Gulf); 56 (larvae of *Cephenemyia* sp. from nasal passages of caribou, May 25, Bernard Harbour).

"Caribou": Stefánsson, 1919: 310 (hunting in the Arctic).

"Caribou": Whittaker, 1919: 166 (in greater numbers than usual, E. of Slave River, winter); 167 (1,000 does crossing Great Slave Lake in March toward Barren Grounds).

Rangifer arcticus . . . : Buchanan, 1920: 105 (S. in winter to Reindeer Lake and Churchill River, rarely to Cumberland House); 105-108, 128-129 (migration); 105-106, 131 (food); 113-125, 134-137, 142-151 (hunting by Indians and others); 122, 124 (traveling upwind); 125-126 (description); 126 (antler change; gait); 130-131 (numbers); 135-136 (snares); 136-140 (economic uses by Indians).

"Caribou": R. M. Anderson, in Stefánsson, 1921: 743, 750 (Eskimos killing caribou, Victoria Island); 749 (Hood River); 750 (Bathurst Inlet).

Rangifer arcticus . . . (part): Hewitt, 1921: 11-12 (as a source of meat

and clothing); 56 (most abundant of the larger land mammals of the world); 58, 64-66 (place in native economy; range and numbers becoming restricted by excessive slaughter); 59-60 (distribution); 59 (destruction by Eskimos and whalers); 60-63 (migration); 61 (food); 62 (fawning); 67 (warble flies, black flies, and mosquitoes).

Rangifer arcticus . . . : Johansen, 1921: 22-24 (larvae and adults of *Oedemagena tarandi* and larvae of *Cephenemyia* sp., both parasites of caribou, at Bernard Harbour); 29 (adult *Oe. tarandi*, Dolphin and Union Strait); 35, 37 (larvae of *Oe. tarandi*, lower Coppermine River and Victoria Island).

"Caribou": Stefánsson, 1921: 18 (abundant, Banks Island, winter); 227-230 (Norway Island [W. of Banks Island]); 231-234 (qualities of meat and fat); 242-249, 255, 258, 262, 281-283, 358, 364, 397, 369, 372, 473, 475, 476 (hunting on Banks Island); 246-247 (fat); 247 (attacks by insects); 248 (speed according to sex and age); 248-249 (pursuit by wolves); 251 (wariness on Banks Island); 252 (back fat); 255 (perhaps 2,000-3,000 caribou on Banks Island in summer); 307 (sight); 401 (hunting on Victoria Island, September; some migrating S. to mainland); 401-402 (stone monuments used by Eskimos for driving caribou to ambush); 475-476 (relations of caribou and wolves).

"Caribou" or "deer": Jenness, 1922: 15, 17 (migration between mainland and Arctic islands; one route across Cape Krusenstern); 20-21 (Coppermine River to Great Bear Lake); 22 (Cape Barrow to Bathurst Inlet); 25-26 (Victoria Island in summer); 47 (spearing from kayaks in Coppermine region); 48, 101, 248 (use of fat for fuel); 61 (skins as bedding); 78-81 (skins as tent material); 97 (stomach contents eaten by Eskimos); 100-103 (Caribou as food of Eskimos; hunting on ice of Coronation Gulf and on Victoria Island; Coppermine River to Bathurst Inlet); 124 (summer hunting by Eskimos about Dolphin and Union Strait); 125 (October passage from Victoria Island to mainland); 127-142 (hunting on Victoria Island, April to October); 148-151 (Eskimo hunting methods about Coronation Gulf and on Victoria Island; attacks on Eskimos by Caribou); 182-189 (Eskimo superstitions concerning Caribou); 244, 249 (scarcity and destruction at Coronation Gulf).

Rangifer arcticus . . . : R. M. Anderson, 1924: 329 (varying estimates of numbers; Barren Grounds of central mainland); 330 (relations to reindeer).

Rangifer arcticus arcticus (Richardson): Miller, 1924: 491 (nomenclature; type locality).

"Caribou": Blanchet, 1925: 15 (upper Coppermine); 32-34 (migration); 32-33 (sexual segregation); 33 (fawning; food; torment of flies; gait; molt; antler growth and change); 34 (senses; utilization by Indians; wariness; swimming; relations to wolves and foxes; Great Slave Lake to Great Bear Lake and Back's River).

"Caribou": Blanchet, 1926*a*: 73 (trails, Nonacho Lake); 96-97 (trail and signs, Lake Eileen); 98 (caribou in economy of the Caribou-eater Chipewyans).

Rangifer arcticus . . . : Blanchet, 1926*b*: 46-48 (migrations); 47 (fawning in early June; attacks of flies; gait; molt; utilization of hides); 47-48

(antler change); 48 (senses; segregation by sex and age; numbers in millions; Lake MacKay, Great Bear Lake, Lac de Gras, Clinton-Colden and Aylmer lakes; wintering S. to Cree, Foster, and Reindeer lakes).

Rangifer spp.: Ekblaw, 1926: 101 (s. Arctic Archipelago).

"Caribou": Mallet, 1926: 79 (migration; wintering about Reindeer, Cree, Wollaston, and Nueltin lakes and Pakatawagan; predilection for frozen lakes; predation by wolves); 80 (dependence of travelers on Caribou for food; hunting on the ice of lakes).

Rangifer arcticus . . . : Preble, 1926: 119 (Barren Grounds); 121 (depletion along Arctic coast E. to Coppermine River); 125 (Yellowknife Preserve); 137 (Back's River Preserve; great numbers; migration); 138 (Arctic islands; partial migration); 139 (Banks and Victoria islands).

"Caribou": Blanchet, 1927: 145 (Abitau River); 149 (sw. tributary of Dubawnt River, July 5).

"Caribou": Craig, 1927: 22 (Admiralty Inlet; former abundance; depletion by hunting).

"Caribou": Henderson, 1927: 40 (Clyde River, Baffin Island; annual caribou hunt by Eskimos).

"Caribou": Rasmussen, 1927: 5 (Eskimos clad in caribou skin, Melville Peninsula); 20-21 (hunting on Melville Peninsula); 23 (Eskimo stores of caribou meat); 54 (caribou moving N., Baker Lake, May); 59-60, 103, 105 (hunting by Eskimos, lower Kazan River); 63, 68 (Yathkyed Lake); 65 (warble fly larvae as Eskimo delicacy); 67 (decrease in Eskimos and caribou at Yathkyed Lake); 68 (stone cairns for deflecting caribou); 73-77 (Eskimo hunting methods); 104-106 (Eskimos starving for lack of caribou, lower Kazan River); 145 (Eskimos hunting near Admiralty Inlet); 166-167 (caribou obtained by Eskimos, Pelly Bay); 205 (King William Island); 214-217 (migration, September 15-21, King William Island); 245 (Eskimos of Victoria Island living on caribou in summer and autumn); 246 (enormous herds crossing delta of Ellice River; Kent Peninsula becoming depopulated of Eskimos through failure of caribou).

Rangifer arcticus arcticus (Richardson): Anthony, 1928: 530-531 (description); 532 (Barren Grounds; former abundance; destruction).

"Caribou": Kindle, 1928: 72-73 (numbers estimated at more than 30,000,000; utilization by natives for clothing and meat); 74 (economic value of reindeer).

Rangifer arcticus . . . : Birket-Smith, 1929 (1): 9, 47, 57 (importance to Caribou Eskimos); 48 (back fat); 50 (wintering on Barren Grounds; moving against wind; antler shedding; poor quality of winter meat); 51 (wolves hunting caribou; does first on spring migration; fawning in June); 52-53 (Eskimos feasting on caribou in spring); 56 (fawning in late June and early July; great migration at Baker Lake, late July; plagued by *Oedemagena tarandi*; most important Eskimo hunting in late summer and early autumn); 86 (tents of caribou skin among Caribou Eskimos); 89 (Eskimo spade made of antler); 90 (bags of caribou skin; fat for illumination); 94 (skins for household use); 96 (the principal diet among Caribou Eskimos); 98 (hunting by means of fences); 100 (Yathkyed Lake); 101 (heedless slaughter by Eskimos; migration always incalculable; fox-trap-

ping replacing caribou-hunting); 102 (former use of bow in hunting); 104 (arrowheads of caribou bones); 106 (hunting by Eskimos; wariness; keen hearing and smell; buck attacking a man at Vansittart Island; deer-crossings in region of Baker Lake and Kazan River); 107 (Eskimo hunting methods); 108 (snow pitfalls); 109-110 (spearing in water; swimming ability); 110-111 (driving between lines of cairns); 112 (snares); 133 (gadfly larvae as Eskimo delicacy); 134-135 (seasonal hunting); 135 (frequent starvation of Eskimos in lack of caribou); 137 (staple food of Caribou Eskimos); 138-139 (taboos in use of meat); 140-147 (Eskimo dressing of carcasses); 141-144 (raw, cooked, and dried meat in Eskimo diet); 171 (meat as dog food); 186 (deerskin for kayaks); 191, 196, 199-223 (Eskimo clothing of deerskin); 232, 239-251 (various Eskimo uses of skin, bones, and antlers); 262, 263 (Eskimo laws for hunting caribou); 268-271 (drums of deerskin).

Rangifer arcticus arcticus (Richardson): Seton, 1929, **3**: 95-135 (monographic); 97-99 (measurements, weight, color); 102 (distribution); 102-103 (antlers); 104 (molt; senses); 105 (communication; voice); 105-107 (disposition); 107 (aquatic ability); 107-108 (food); 108-109 (Wolves and other predators); 109-110 (effect of mosquitoes); 110-111 (warble and nostril flies); 111-116 (utilization of flesh and hide by natives and civilized man); 113-114 (fat); 117-122 (hunting by Eskimos and Indians); 122 (Artillery Lake to Back's River; Arctic islands; migration); 124-125 (reproduction); 125-127 (migration); 127-128 (wintering between Great Bear, Great Slave, and Athabaska lakes and Hudson Bay); 131 (Mackenzie River to Cape Bathurst; Langton and Darnley Bays); 131-134 (numbers perhaps 30,000,000); 133-134 (destruction by Indians, whalers, and Eskimos).

"Caribou": Blanchet, 1930: 49 (E. of Great Bear, Great Slave, and Athabaska Lakes; fawns born in late May or June; antler growth and shedding); 49-52 (migration; Lac de Gras, Lake MacKay, Beverly, Aberdeen, and Baker lakes; Coppermine, Lockhart, Taltson, Dubawnt, Kazan, and Ferguson rivers; S. to Cree and Reindeer lakes and Churchill; only a small migration now from Victoria Island to mainland; Wager and Repulse bays); 50-51 (importance to Indians and Eskimos; Dawson Inlet to North Seal River; inland from Eskimo Point and Nunalla; Padlei); 52 (food destroyed by fire; several millions); 53 (fawning area); 53-54 (possibilities for reindeer); 54-55 (relation of wolves to caribou).

Rangifer arcticus (Richardson): Critchell-Bullock, 1930: 55 (Artillery Lake; weight; therapeutic value of meat); 58 (Thelon River, thousands, late July); 143 (use as fox bait); 159-160 (numbers); 159-162 (useful role of Wolf as Caribou predator); 192 (wind direction scarcely affecting migration; Artillery Lake, mostly bucks, September to November; bucks getting lean, October 17; antlers dropping and flesh improving, November 7; practically all (buck) antlers dropped, November 19; Artillery Lake, several hundred does, November 4, then continuing to pass N. during winter; bands of bucks passing S., November 26 to December 9; young bucks with does during winter; does dropping antlers, March 24 to mid-April; all does gone N. by April 27; bucks moved N. of Hanbury River by June 20; main s. migration, Thelon River, July 23; all sexes and ages, in bands

up to 2,000—total number 10,000+); 193 (scourged and driven by insects; voice; stage of pelage differing in sexes; delta of Dubawnt River; possibly yearling doe with fawn; flies gone August 24, animals putting on fat; does massing in September, hundreds slaughtered by Eskimos at Thelon-Dubawnt mouth; last seen, Baker Lake, September 5); 194-196 (table of Caribou movements—localities, dates, numbers, sex, wind.)—1931: 32 (conservation); 33 (trade in hides; Back's River Eskimos living "solely" on Caribou).

"Caribou": Hoare, 1930: 13 (bucks migrating NE., June, Artillery Lake to Ford Lake); 14 (10,000+ near Campbell Lake, going SW., late July); 16 (bands near Smart Lake, August); 21 (Ford Lake, early December); 22 (Artillery Lake and Pike's Portage, numerous, December; wolf predation); 27 (small bands swimming lower Thelon River, late June); 31 (swimming Hanbury River, July); 33 (great numbers of bucks going S. Thelon River, July 22; relation of migrations to insects and storms); 36 (circular migration about e. end of Great Slave Lake; ne. migration in spring down Thelon River); 37-38 (relation of migration to mosquitoes); 52-53 (summation by R. M. Anderson: carrying capacity of range—60 acres per Caribou; probably total not over 3,000,000).

Rangifer arcticus . . . : Kitto, 1930: 87 (food; economy; numbers and depletion; migrations); 88 (effect of firearms; segregation of sexes and ages); 89 (wolves; insect pests); 89-90 (conservation measures); 110 (Keewatin, mainland and Southampton and Coats islands; Churchill, Eskimo Point, and Baker Lake).

"Caribou": Mallet, 1930: 13 (Eskimo clothing of skins, Kazan River); 20-23 (great migrant herd, led by a doe, crossing Kazan River near Yathkyed Lake); 27 (small herds migrating S., Ennadai Lake, August); 32 (Chipewyan drum of caribou skin); 85 (Eskimos between Nueltin and Baker lakes living on caribou); 87 (Eskimo clothing of caribou fur); 89 (Eskimos starving for lack of caribou); 90 (500 consumed per winter by 20-odd Eskimos); 92 (caribou-skin gloves; tongues as provisions for journey); 95 (Eskimos eating raw frozen caribou in winter and "lukewarm meat" in summer); 102 (Eskimo tent of skins on Kazan River); 116 (Indians eating caribou on Kasmere River); 131-140 (Eskimo band succumbing to starvation for lack of caribou).

Rangifer arcticus arcticus Richardson: Jacobi, 1931: 78-80 (description); 80-84 (N. to Baffin Island and other Arctic islands; E. to Hudson Bay, Southampton Island, and Melville Peninsula; S. to Churchill River, Reindeer Lake, and Fort McMurray; W. to Athabaska and Mackenzie Rivers); 140 (phylogeny); 156, 157, 159 (depletion by natives, whalers, and traders); 186-187 (habitat); 190 (occurrence in herds); 192-210 (migrations: causes, extent, routes, numbers, behavior, segregation by sex and age, dates, winter quarters); 216 (swimming); 219, 220 (unwariness; curiosity); 223 (food); 232 (reproduction); 236 (molt); 237 (change of antlers); 240-241 (predation by wolves); 244-245 (parasitic flies).

Rangifer arcticus arcticus (Richardson): Harper, 1932: 30 (Lake Athabaska; excessive slaughter by Indians; Tazin Highlands; food; Thainka Lake; junction of Tazin and Taltson Rivers; avoiding lower Taltson River after

fire); 31 (Great Slave Lake; "near Artillery Lake" [=Stark Lake?]; Indians spearing hundreds in water; migration; havoc by wolves; Caribou-eater Chipewyans).

"Caribou": Jenness, 1932: 47, 48, 58, 59 (caribou in Indian economy); 51, 58, 75, 406-408, 411, 412, 414, 415 (caribou in Eskimo economy).

"Cariboo" or "deer": Munn, 1932: 57 (Artillery Lake); 58 (great migration of perhaps 2,000,000 between Artillery and Great Slave lakes; relation to mosquitoes); 168 (Baffin Island); 191-192 (Eskimo sleeping-bags and clothing of caribou skin, Baffin Island); 210, 214 (Eskimos hunting deer, Southampton Island); 255 (trade in skins from Melville Peninsula); 271 (depletion of Baffin Island herds); 278 (decimation of caribou in w. Arctic due to Eskimos trapping white fox instead of sealing in winter).

Rangifer arcticus arcticus (Richardson): Sutton and Hamilton, 1932: 33, 35, 36, 81, 82, 84, 85 (predation by wolves, Southampton Island); 79 (formerly abundant, but no longer); 79, 81 (migration); 80-83, 86-87 (hunting and utilization by Eskimos); 81 (scatology); 81, 84-86 (reproduction); 81-86 (antler growth and shedding); 83 (standing on hind legs); 84 (food; foot-glands; voice); 84-86 (parasitic and other flies); 87-88 (description); 88 (previous records on Southampton Island).

Rangifer tarandus arcticus . . . : Weyer, 1932: 38 (most important land animal to Eskimos); 39 (utilization by Eskimos; food); 40 (fawning period; seasonal fat; migration).

Rangifer arcticus . . . : Birket-Smith, 1933: 89 (immense numbers on Barren Grounds, but recently declining); 90 (gadflies plaguing caribou); 91-92 (migration); 92 (thousands at Baker Lake, late July; scourged by mosquitoes); 93 (no longer migrating from Victoria Island to mainland); 94 (occurrence in autumn and winter at Repulse Bay); 100 (good hunting near Whale Point, Roe's Welcome; use of cairns in hunting by Eskimos); 106 (not many near Eskimo Point); 112 (great migration at Baker Lake beginning in June); 118 (deer crossings on lower Kazan River); 121 (difficulty of reconciling reindeer culture with presence of caribou).

"Caribou": Ingstad, 1933: 34 (caribou deflected on s. side of Great Slave Lake by forest fires); 48 (buck on Barren Grounds harassed by black flies); 85, 110 (E. of Great Slave Lake); 86 (asleep on ice of lakes); 87 (leaping into air before running off); 88 (varying wariness); 90 (carcass as fox bait near Artillery Lake); 118, 122 (use of meat and hides by Indians, Great Slave Lake); 134-135, 324 (spring migration across Great Slave Lake); 135 (antler velvet eaten by Indians; larvae of nostril and warble flies); 139 (Indian drum of caribou skin); 156-159 (migration; followed by wolves, ravens, foxes, and wolverines); 158 (rutting season and behavior); 159 (antler shedding); 160 (numbers); 161 (migration influenced by grazing available; fawning on Arctic islands); 162 (separation into different herd groupings); 162-163 destruction by Eskimos with firearms along Arctic coast); 163 (migration deflected by burning of country); 165-166 (conservation; wolf predation); 167 (dependence of Caribou-eater Indians on this animal); 176, 181 (Stark Lake and vicinity); 186-187 (use of meat by Caribou-eaters); 204, 216, 218, 220, 222 (upper Thelon River region); 207 (predation

by wolves); 225, 229-231 (Nonacho Lake area); 247, 253 (dependence of Barren Ground Indians on caribou); 253-254 (former hunting with spears, bows, dogteams, barriers, snares); 257-259 (Indian use of meat and hides); 280 (migrating near e. end of Great Slave Lake); 291, 293, 296 (thousands in winter on Barrens E. of Great Slave Lake; 293, 297 (unwariness); 302-304, 306-307 (predation by wolves on Barren Grounds); 312 (albino caribou).

"Barren land caribou": Stockwell, 1933: 45 (large herds in August, Point, Thonokied, and MacKay lakes and Coppermine River).

"Caribou": Weeks, 1933: 65 (very plentiful on Maguse River after August 4).

Rangifer arcticus arcticus (Richardson): R. M. Anderson, 1934*a*: 81 (utilization of skin and meat; migrations; Melville Peninsula, Boothia Peninsula, and Baffin Island).

Rangifer arcticus . . . : R. M. Anderson, 1934*b*: 4062, fig. 9 (map shows range of subsp. *arcticus* extending N. only to Arctic coast and over Baffin Island).

Rangifer arcticus . . . : Flerov, 1934: 240 (cranial measurements).

"Caribou": Godsell, 1934: 273-276 (trade with Eskimos on Arctic coast resulting in great slaughter of caribou); 276 (importation of reindeer to Mackenzie Delta region to replace caribou).

Rangifer arcticus (Richardson): Hornby, 1934: 105 (food; weight; fat; migrations influenced by natives, unfrozen large lakes, and fires; effects of flies; rutting season and behavior; antler shedding); 106 (irregular migrations; sexual segregation; wolf predation); 106-107 (movements, numbers, and dates in region between Great Slave and Baker lakes); 108 (beneficial effect of wolves on caribou).

"Caribou": Wray, 1934: 141 (abundant, Lac de Gras, 1932); 144 (few S. of Mackay Lake).

Rangifer arcticus arcticus (Richardson): Degerbøl, 1935: 48-51 (specimens from Baffin Island and Melville Peninsula, including an albino from Rae Isthmus; descriptions).

"Caribou": Freuchen, 1935: 93 (abundance of rabbits supposed to lessen wolf predation on caribou); 99 (wolverine reputed to attack sleeping caribou); 120 (pursuit by wolves near Wager Inlet); 121 (followed by wolves, Melville Peninsula; predation by wolves, Southampton Island); 122 (wolves said not to follow caribou across streams; wolf methods of hunting caribou); 128 (caribou carcasses consumed by Arctic foxes).

Rangifer arcticus arcticus (Richardson): Murie, 1935: 74, 75 (type locality; skull measurements).

"Barren ground caribou": Alcock, 1936: 9 (Lake Athabaska).

Rangifer arcticus . . . : Birket-Smith, 1936: 90 (importance to Eskimos); 91 (migration; snow pitfalls, baited with urine; hunting with spears, rows of stone cairns, snares, and bows); 110 (dependence of Caribou Eskimos on Caribou); 111 (frequent famine and cannibalism among them for lack of Caribou; lookout knolls for Caribou); 112 (sexual segregation in herds); 115-116 (clothing of caribou skin).

"Caribou": Soper, 1936: 429 (resorting to Grinnell Glacier, Baffin Island, to escape mosquitoes).

Rangifer arcticus arcticus (Richardson): R. M. Anderson, 1937: 103 (lower

Mackenzie River to Hudson Bay; use of skin and meat; scarce on coast W. of Bathurst Inlet; concentration between Bathurst Inlet, Great Slave Lake, and Baker Lake; S. into Wood Buffalo Park; use of rifles by Central Eskimos resulting in decrease; apparent intergradation with *R. a. pearyi* in northern islands).

"Caribou": Godsell, 1937: 288 (caribou migrating between mainland and Arctic islands exterminated by Eskimos with ammunition supplied by traders); 289 (reindeer imported to mouth of Mackenzie to replace vanished caribou).

Rangifer arcticus . . . : Henriksen, 1937: 25 (larvae of *Cephenomyia trompe* L. from nasal passage, Baker Lake, May 2); 26 (larvae of *Oedemagena tarandi* collected from caribou in May, Gore Bay, Lyon Inlet, and Melville Peninsula).

Rangifer arcticus arcticus . . . : R. M. Anderson, 1938: 400 (perhaps no great reduction in numbers, but some shifting of range from human encroachments and fire; wintering S. to n. Manitoba and Saskatchewan and ne. Alberta; estimate of 3,000,000).

Rangifer arcticus . . . : Hamilton, 1939: 109 (hoofs; function of fat); 244-247 (migrations); 246, 352, 359 (importance to Indians and Eskimos); 247 (influence of mosquitoes on movements; sexual segregation); 301 (distribution determined by insect pests); 359 (immense herd in ne. Saskatchewan).

Rangifer arcticus arcticus Richardson: Murie, 1939: 239 (Mackenzie River to Hudson Bay and Baffin Island, including some of the Arctic islands; diagnosis); 244 (antlers; pelage; migration; rut in September and October); 245 (food; ankle click; voice; gait; senses; insect pests; Wolves and other predators); 245-246 (danger from introduction of Reindeer); 246 (adaptation to environment).

Rangifer arcticus (Richardson): Clarke, 1940: 5, 7 (dependence of Indians and Eskimos on caribou); 8-9 (Rum Lake country a wintering ground; Eskimos from Back's River to Wager Inlet and Baker Lake dependent on winter caribou; likewise those at Beverly, Aberdeen, and Schultz lakes); 11 (great winter herd S. and W. of Bathurst Inlet); 65 (fluctuations; current abundance in Hanbury-Thelon region and scarcity at Baker Lake); 70 (parasites; diseases); 84 (economic importance); 85-86 (migrating southward in late July in Thelon Game Sanctuary and at Tourgis Lake, in early August at Hanbury, Artillery, Clinton-Colden, and Aylmer lakes, and from early August to late September at Taltson River and Thekulthili and Nonacho lakes; in autumn near Lac de Gras and on upper Back's River; in autumn and winter at Reliance and Snowdrift); 87-90 (at least 100,000 migrating N. in early July at Hanbury and Thelon rivers, including does with month-old fawns); 89, 90 (molt); 91 (previous records in Thelon Sanctuary region); 92-93 (near Lake Athabaska and Slave River and at Hill Island Lake in early August; Wood Buffalo Park in winter; the various groups and their movements defined); 93-95 (early ideas of migrations); 95 (fallacies; sexual segregation; antlers; influence of flies); 96-97 (details of migratory movements; retrograde autumnal movement); 98 (extermination of bands formerly migrating from mainland to Victoria and King William islands); 98-100 (irregular migrations; influences—

such as wide open waters, overgrazing, and fires—affecting migrations); 101-104 (carrying capacity of range; numbers estimated at 3,000,000; increase and decrease); 104-106 (accidents); 106-107 (effects of fire and overgrazing; food); 107-110 (wolves and other predators); 110 (hunting and its effects); 112 (importance to natives).

Rangifer arcticus arcticus (Richardson): G. M. Allen, 1942: 297 (mainstay of Eskimos and Indians); 297-298 (description); 298-299 (Hudson Bay to Mackenzie River, N. to Banks and Victoria Islands, Boothia, Southampton and Baffin Islands, S. to Churchill River, Reindeer Lake, and ne. Alberta; migratory habit; shift of range due to human crowding and destruction of winter forage by fire); 299 (increased slaughter in winter range; reduction on Southampton Island).

"Caribou": Manning, 1942: 28 (rapidly reduced on Southampton Island after establishment of a post in 1924); 29 (insufficient skins for Eskimo clothing); 29 (wolves, for lack of caribou, became extinct on Southampton by 1937).

Rangifer arcticus arcticus (Richardson): Soper, 1942: 143 (in 1932-33, E. of Fort Smith, S. to 30th base line; along N. shore of Lake Athabaska to Fond du Lac; W. of Slave River, between Lobstick Creek and Grand Detour and into Wood Buffalo Park; Tethul River to Tsu Lake and Taltson River; in 1933-34, crossing Slave River from E. in vicinity of Caribou and Stony Islands and Buffalo Landing, and feeding on goose grass [=*Equisetum, fide* Raup, 1933: 39]).

"Caribou": Downes, 1943: 203 (Windy Lake, late July); 215 (1925-26 and 1938-39 bad years for caribou on upper Kazan River; consequent mortality among Eskimos); 221 (Red River, July 28); 224, 249, 250 (Simons' Lake); 226 (grunting; shaking heads on account of flies; buck with winter pelage); 227 (butchering operation); 228 (use of antlers and hoofs; feeding on dwarf birch; protecting carcasses from gulls); 236-237 (antics of a buck); 253 (Red River); 255 (warble and nostril flies); 256 (does beginning to appear; swimming ability); 256-257 (snuffing, snorting, and coughing); 258-260 (estimates of numbers); 260 (change of migration routes through human activities and forest fires); 261-262 (effect of natives and wolves); pl. following p. 296 (Kasmere River).

Rangifer arcticus (Richardson): Manning, 1943*a*: 47 (recent depletion by Eskimos); 49-52 (w. Baffin Island; Koukdjuak and Hantzsch rivers; Bowman, Taverner, Wordie, and Harbour bays; Tweedsmuir Islands; Baird Peninsula; Lake Nettilling; Cumberland Sound; Fury and Hecla Strait); 50 (summer and winter droppings; exterminated from most of Foxe Peninsula); 51 (estimated population in central western Baffin Island 10,000); 51-52 (migratory movements); 52 (sexual segregation and herding; females bearing young at end of second year); 52-53 (antler growth and shedding); 53 (molt; development of warble flies, and their scarcity in fawns; accumulation of fat); 55 (annual kill by wolves on w. Baffin Island estimated at 2,000 animals over one year of age).

"Caribou": Manning, 1943*b*: 103 (former migration—now ceased—from the S. to Melville Peninsula, where the animals are now scarce; still numerous on Baffin Island N. of Fury and Hecla Strait; fairly numerous, Repulse Bay

to Chesterfield Inlet; dearth of skins for Eskimo clothing; numerous herds about Piling, Baffin Island).

Rangifer arcticus arcticus . . . : Porsild, 1943: 383 (food); 386 (warble and nostril flies "apparently do not travel very far"; sparsely covered grazing areas suitable for caribou but not for reindeer); 389 (migration affected by rotational grazing and seasonal and local abundance of mosquitoes or flies; wariness varying with size of herd; caribou disappear before expanding reindeer culture).

Rangifer arcticus arcticus (Richardson): Soper, 1944: 274-250 (great reduction in southern coastal region of Baffin Island; few left on Foxe Peninsula; Hantzsch and Soper rivers; Bowman, Amadjuak, and Frobisher bays; Lake Harbour; Nettilling Lake; Big Island; Grinnell Glacier; Cockburn Land); 248 (measurements); 248-249 (migrations); 248-250 (utilization by Eskimos).

"Caribou": [U. S.] War Department, 1944: 40 (Canadian mainland and Arctic islands); 77 (importance as food).

"Barren ground caribou": Wright, 1944: 185 (late summer skins for clothing; high value of the meat; reduction in numbers); 186 (migration routes changed by overgrazing, fires, and excessive hunting; numbers); 187 (annual consumption in Keewatin not less than 22,000; decrease on Boothia and Melville peninsulas; locally plentiful in w. Baffin Island; scarce on King William Island; none on Adelaide Peninsula; great decrease on Southampton Island); 188 (small herds on Coats Island; varying numbers on Baffin Island, where skins are imported for clothing; a herd on Bylot Island); 189 (scarce at Arctic Bay and on Brodeur Peninsula); 190 (migration on Baffin Island); 191 (Baffin population estimated at 25,000); 193 (tables of numbers taken annually on Baffin Island and in Keewatin); 195 (smaller caribou on Boothia Peninsula and on Somerset and Prince of Wales islands).

"Caribou": Young, 1944: 236-238, 243 (predation by wolves in the Barren Grounds, including Southampton Island and Artillery Lake).

Rangifer arcticus arcticus (Richardson): Gavin, 1945: 227-228 (recent increase at Perry River and Bathurst Inlet; partly resident on mainland but also migratory, a few crossing to Victoria Island); 228 (many fawning on small coastal islands and Kent Peninsula; many succumbing to mosquitoes; damage by larvae of warble fly).

Rangifer arcticus arcticus (Richardson): R. M. Anderson, 1947: 178 (type locality; Mackenzie and Keewatin, from Hudson Bay and Melville Peninsula W. to lower Mackenzie Valley, and N. to s. fringe of islands N. of the mainland Arctic coast; migrating S. to Churchill River or beyond, Reindeer Lake, Lake Athabaska, and occasionally the Wood Buffalo Park in ne. Alberta).

Rangifer arcticus . . . : R. M. Anderson, 1948: 15 (decrease; shift of range attributed to fire or overgrazing; need of protection; killing from planes; Northwest Territories; northern Manitoba, Saskatchewan, and Alberta).

Rangifer arcticus (Richardson): Manning, 1948: 26-28 (Eyrie, Big Sand, Neck, Sandhill, Malaher, Boundary, Boulder, South Henik, Camp, Carr, Alder, Victory, Ninety-seven, Twin, and Baker lakes; Tha-anne and Kazan rivers; W. of Padlei; Christopher Island; Chesterfield Inlet; Tavani;

most numerous in the more southerly and westerly of these localities in Manitoba and Keewatin; heavy grazing on lichens where the caribou had been numerous; migration; trails).

Rangifer arcticus arcticus Richardson: Rand, 1948*a*: 211-212 (diagnosis); 212 (Northwest Territories, wandering southward in winter as far as Fort McMurray (formerly) and Wood Buffalo Park; food; habitat).

Rangifer arcticus Richardson: Rand, 1948*b*: 149 (numerous at Burnt Wood River, W. of Nelson House, winter of 1944-45, and in Herb Lake area, Manitoba, winters of 1944-45 and 1945-46; hundreds killed by Indians).

"Caribou": Yule, 1948: 287 (a losing battle for survival; not half as many as a few years previously); 288 (considerable herds between Churchill and Gillam, but fewer to the westward; excessive kill; consumption by dogs and wolves; disaster confronting Indians and Eskimos through diminishing supply of caribou).

Rangifer arcticus arcticus . . . : Banfield, 1949: 477 (economy); 478 (Mackenzie and Keewatin; numbers less than previous estimate of 3,000,000; S. in winter to nw. Ontario, central Manitoba, n. Saskatchewan, ne. Alberta, Wood Buffalo Park, and Norman Wells; small bands remaining on Boothia and Adelaide peninsulas, S. of Pelly Bay, on Somerset, Prince of Wales, and Russell islands, and at Daly Bay; believed extirpated on King William Island; Melville Peninsula); 481 (near Wager Bay; fairly plentiful along Arctic coast from Back's River to Horton River, in Perry River district, and on Kent Peninsula, where a few cross to Victoria Island; population on Southampton Island estimated at 300, on Coats Island at 1,000 and on Baffin Island at 25,000; apparently extirpated on Bylot Island in 1941; Eskimo pressure on Baffin Island herds). (Fig. 1 suggests n. limit at s. Victoria Island and Prince of Wales and Somerset islands.)

Rangifer arcticus arcticus . . . : Harper, 1949: 226 (Kazan River; Eskimos starving for lack of caribou); 226-230, 239-240 (migration and its pattern); 226 (wintering S. to Churchill and Nelson rivers; Nueltin Lake); 226, 228 (habitat; trails); 226-227, 229-230 (locomotion); 227 (daily periods of rest); 228, 229, 230 (pelage and molt); 228 (insect pests); 228, 229 (organization of herds); 229 (antlers); 229-230 (disposition); 230 (grunting; shaking water off; foot-glands; food); 230-231 (utilization of hides and meat); 230-231, 239 (the wolf a beneficial predator); 231, 239 (numbers); 239 (civilized man the chief enemy; menace of reindeer culture).

"Caribou": Hoffman, 1949: 12 (herds of 50,000 in Mackenzie region spotted by aircraft; Indians and Eskimos thus directed to them; caribou hides shipped to Eskimos along Arctic coast, who are thus giving up seal-hunting).

Rangifer arcticus agg.: Polunin, 1949: 24 (contemplated introduction of Reindeer to replace Caribou); 72 (Frobisher Bay); 227, 230 (reported increase in NE. of Southampton Island); 230 (Eskimos on Southampton Island learning conservation methods); 233, 238, 262, 264 (Christopher Island, Baker Lake).

"Caribou": Porsild, 1950: 54 (relatively plentiful, 1949, Banks and Victoria islands).

"Barren-ground caribou": Banfield, 1951*a*: 1 (importance in northern economy); 3 (physical environment); 4 (former and present distribution);

4-5 (winter ranges); 5 (influences of fire on distribution); 6 (summer ranges; retrograde autumnal movement); 9 (estimated mainland population 670,000); 9-12 (migration); 10 (retrograde autumnal movement; rutting in October or November); 11 (influences of excessive hunting and fires on migration); 12-15 (changes in range and status); 13 (estimated population of 1,750,000 in 1900); 14-15 (destruction by whalers and natives); 15-17 (description; pelage and molt); 15 (weight); 17-18 (antler growth and change); 18 (tooth wear with age); 19 (body form; foot-prints; foot-click); 19-20 (food); 21 (locomotion; swimming); 22 (voice; senses; disposition); 23-24 (group behavior); 24-26 (sexual segregation); 26 (rutting behavior); 27 (fawning behavior; warning behavior); 27-29 (influence of food, weather, and flies on migration); 30 (vital statistics; growth); 31 (sexual maturity); 31-33 (warble flies); 33 (nostril flies, mosquitoes, and black flies); 33-35 (internal parasites); 35 (bacterial diseases); 35-36 (accidents); 36-37 (relations to other animals); 37-41 (relations to wolves; annual loss from wolf predation estimated at no more than 5 percent); 41 (wolverine only a scavenger); 42 (few kills by barren-ground grizzlies or golden eagles); 42-43 (effect of firearms and wastage by natives); 43-44 (caches); 44-45 (meat used as human food, dog feed, and fox bait); 46-47 (hides used for clothing, upholstery, tents, moccasins, etc.); 47 (use of sinew, antlers, and fat); 47-50 (human population in caribou range; annual kill estimated at 93,000 as a minimum).

Rangifer arcticus arcticus (Richardson): Banfield, 1951*b*: 120 (Mackenzie; wintering in forest, summering on tundra; specimens).

"Caribou": Scott, 1951: 17 (Musk Ox Lake, Mackenzie); 19 (near Beechey Lake); 37, 41, 83, 87, 88, 175, 214, 216 (Perry River, Keewatin); 127 (use by Eskimos); 179, 180 (doe with fawn, July 21); 199 (several thousand, July 27); 234 (Baker Lake).

"Caribou": Tweedsmuir, 1951: 18 (reduction on Baffin Island); 37 (Salisbury Island); 111 (gone from Foxe Land).

"Caribou": Anonymous, 1952: 261 (decline in numbers from 1,750,000 in 1900 to 670,000 in 1952); 263, 265, 267 (wolves harrying herds); 264 (annual kill estimated at 100,000; natural enemies account for 68,000 more); 267 (summer and winter ranges mapped).

Rangifer arcticus arcticus . . . : Mochi and Carter, 1953: pl. 9, fig. 3, and accompanying text (description; distribution).

"Caribou": Harper, 1953: 28 (caribou bodies in Nueltin Lake region fed upon by Rough-legged Hawks, Ravens, and Herring Gulls); 40 (lack of Caribou leading to large consumption of Ptarmigan as dog feed); 41 (Caribou preferred to Ptarmigan as Eskimo food); 60 (Long-tailed Jaegers feeding on caribou bodies); 62, 63 (depredations by Herring Gulls on caribou bodies); 64 (Ring-billed Gulls feeding on caribou bodies); 72 (Canada Jays as substitute for dog feed when caribou are lacking; these birds as scavengers on caribou bodies); 74 (Ravens and Canada Jays as scavengers); 76 (Ravens feeding upon caribou bodies and following Wolves in expectation of a caribou kill).

"Caribou": Barnett, 1954: 96 (migration; fawning; numbers); 103 (migration); 104 (warble fly; antlers); 106 (lichens as food).

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The principal items selected for inclusion in this index are: names of animals other than Richardson's Barren Ground Caribou (*Rangifer arcticus arcticus*); names of plants; names of institutions; and names of authors and other persons.

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